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Jacob-Ryan Vegetation Management Environmental Assessment

USDA, Forest Service

North Kaibab Ranger District

Kaibab National Forest

Coconino County, Arizona

T 38, 39, 40N; R 1, 2, 3E and R1W

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List of Figures

List of Tables

CHAPTER 1 – INTRODUCTION

Background

The original Jacob-Ryan Vegetation Management Project was initiated in 1998. The project started as an environmental assessment (EA) and then was changed to an environmental impact statement (EIS). The original Jacob-Ryan Project covered 33,000 acres and proposed treatments to enhance wildlife habitat, reduce fuels, remove hazard trees, and restore meadows in ponderosa pine, aspen, and pinyon-juniper woodlands. The Notice of Intent to prepare an EIS was removed from the *Federal Register* on December 14, 2007. The project was re-evaluated, revised, and re-initiated. The revised project is the subject of this Environmental Assessment; the current project is smaller, less complex and focuses on vegetation management of the ponderosa pine forest around Jacob Lake and the surrounding area.

The project is located on the North Kaibab Ranger District of the Kaibab National Forest in Coconino County, Arizona (Townships 37 and 38 North and Ranges 1 and 2 East). Figure 1 shows the general vicinity and Figure 2 shows the project analysis area. U.S. Highway 89A and Arizona Highway 67 pass through the project area. Highway 67 continues through the Warm Fire burn area and is the main access to the North Rim of Grand Canyon National Park. The original Jacob-Ryan Project proposal included several hundred acres that burned in the Warm Fire. The areas burned in the Warm Fire have been excluded and are no longer part of this proposal.

There are approximately 1,000 acres or 4 percent of the project area infected with dwarf-mistletoe. It occurs in both even-aged and uneven-aged stands. Mistletoe infected areas are widely distributed across the project and are generally patchy in nature with discrete infection centers. Mistletoe infected trees are treated as they occur within the larger context of the overall stand treatment by (1) removing the infected source trees if they are less than 18 inches DBH and the understory is relatively disease free; (2) leaving infected trees if they are greater than 18 inches DBH as future snags for wildlife, but remove understory trees around the sources of infection, or (3) doing nothing if the infected tree is greater than 18 inches DBH if the tree is isolated and not at risk of spreading mistletoe infections. Regardless of mistletoe infection status, desired conditions for canopy cover and size-class distribution apply.

There are 884 acres of developed recreation sites, private in-holdings and government facilities within the project area that are considered wildland-urban interface (WUI). These WUI areas are not being treated under this proposal. Also 886 acres of steep slopes and non-pine type vegetation have been removed from the project to protect soil resources. The revised project area is approximately 26,000 acres. The project lies within the Grand Canyon National Game Preserve, the Kaibab Squirrel National Natural Landmark, and Arizona Game and Fish Game Management Unit 12A.

The Kaibab National Forest Plan divides the Forest into geographic areas (GA) which contain specific desired conditions and management direction. The Jacob-Ryan project is in GA 13, which is managed for multiple-use. It emphasizes group selection silviculture that moves the stand structure towards uneven-aged conditions similar to the historic forest. This project was developed in order to move the area towards the desired conditions in the Forest Plan.

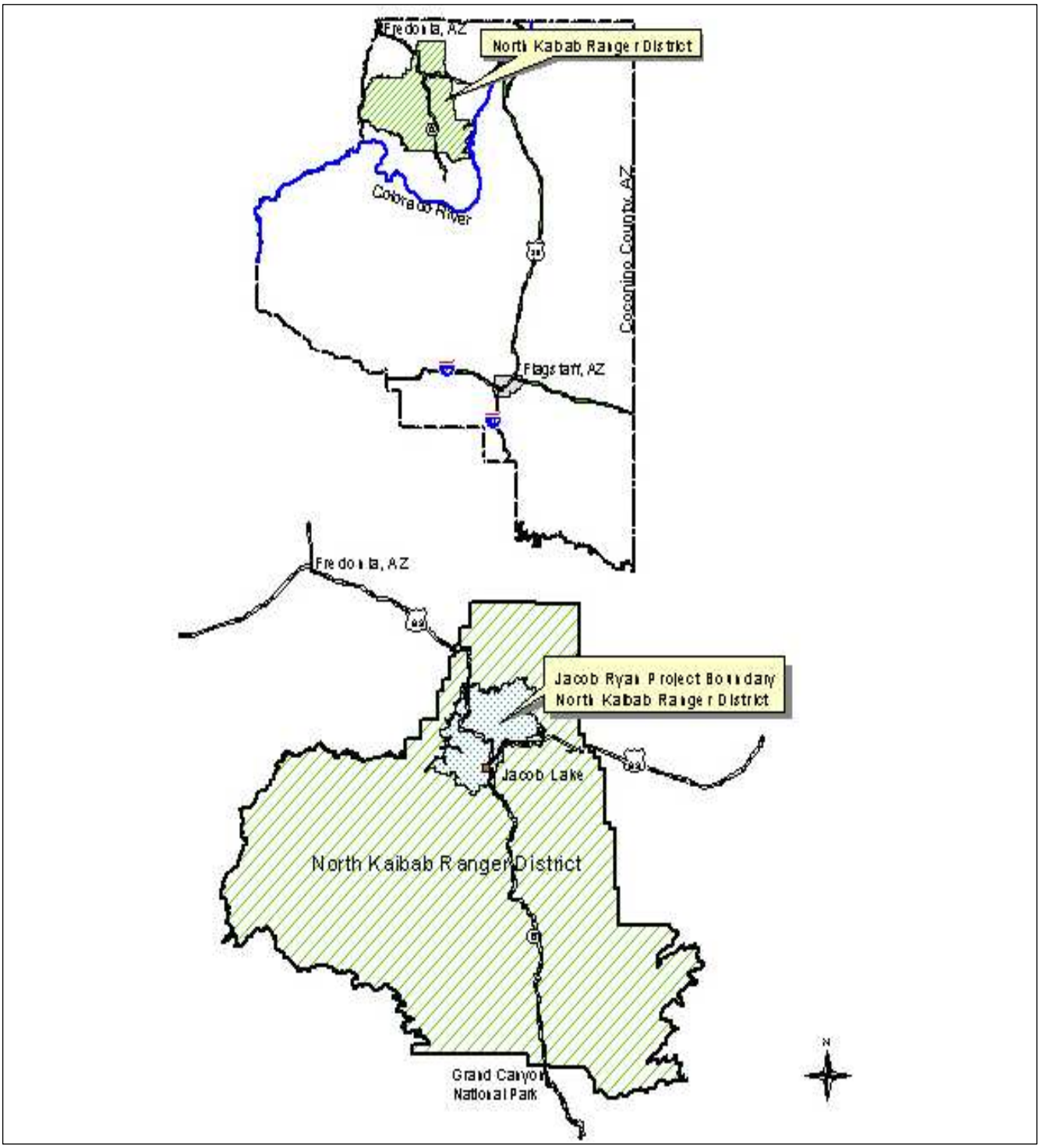

Figure 1—Jacob-Ryan Vegetation Management Project locator and vicinity map

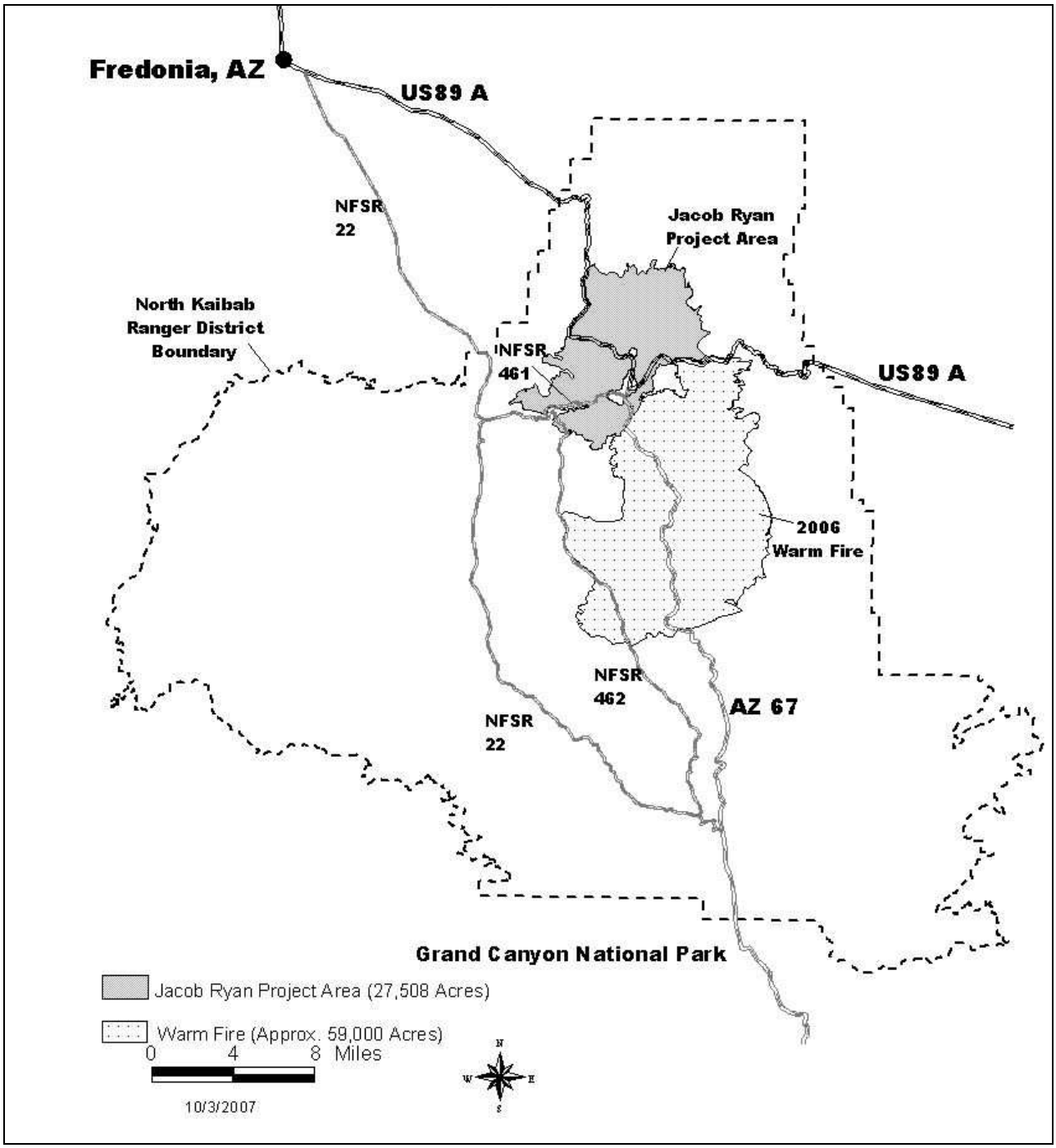

Figure 2—Project analysis area situated on the North Kaibab Ranger District

Purpose and Need for Action

There is a need to reduce ladder fuels, fuel loads, and fire-flame lengths to better manage fires in the project area. There is a need to reduce stand densities to promote a sustainable size-class distribution and an interspersed mosaic of vegetative structural stages in an uneven-aged forest structure. The desired forest structure has lower tree densities than current conditions and is adapted to frequent low-intensity fire. The desired forest structure is based on management recommendations in the Kaibab Forest Plan (as amended 2004) for maintaining northern goshawk breeding habitat and abundant populations of its prey (Reynolds et al. 1992). The purpose and need for the project was developed from comparing the existing conditions to the desired conditions as displayed in the following summary of analysis.

Objectives

- Bring the area more in line with the desired uneven-aged stand structure, which is an interspersed mosaic of vegetative structural stages with a lush and diverse understory.
- Reduce competition, and increase resistance to insects and disease.
- Design and implement management practices to maintain or improve long-term productive capacity of the soil resource.
- Reduce the risk for uncharacteristic stand-replacement wildland fires by reducing flame lengths, ladder fuels, tree densities and fuel loads, and by creating openings in the forest canopy.

Existing Condition

Even-Aged Stands

Approximately 25 percent of the stands in the project area (6,640 acres) are even-aged as a result of past shelterwood seed harvests[1]. Some even provide goshawk post-fledging family areas and foraging areas explained later in the document. These stands are dominated by trees less than 12 inches in diameter, with a few large older trees that had been left as seed trees. Figure 3 shows an area representative of this dense stand structure, which lacks tree size diversity. These even-aged stands are averaging 450 trees per acre with a mean tree diameter of 5.1 inches (Table 1). The attributes in the table are measured for the current condition, and forecasted for years 2028 and 2048 to include trees per acre, basal area, average tree diameter at breast height (DBH) and stand density index (SDI)[2].

Table 1—Even-aged stand statistics for tree density, and size over time

YEAR	TREES/AC	BASAL AREA	AVE. DBH	SDI*
2008	448	55.5	5.1	132
2028	402	90.0	7.1	193
2048	347	120.0	8.9	237

[1] Shelterwood-seed tree treatment is a 2 or 3 step harvest treatment in even-aged stands that removes 30% to 40% of the overstory in the first phase to improve stand health, wind firmness and provide growing room for remaining trees. Phase 2 removes 40% to 50% of the remaining trees, retaining the healthiest trees with the best form to act as a seed source.

[2] Stand Density Index (SDI) is a measure of relative density based on average tree size, and density (trees per acre). The maximum SDI and carrying capacity for a ponderosa pine stand is 450-10 inch trees (DBH).

The problem as displayed in Table 1 is that the stands are overstocked and the trees are very slow growing. The stand rating indicates that there is critical competition between individual trees for water, nutrients and growing space, which will also limit understory grass and forb production. These stands were modeled over time to show how slowly the trees grow over the next forty years. These slow growing, densely stocked stands are at risk for insect and disease attack and uncharacteristic wildfire (see Silviculture and Fuels Specialist Report-PR41 & 44). Full stocking for a ponderosa pine site that includes all size classes is about 150 trees per acre. With No Action, these stands are more than twice recommended stocking levels after 40 years.

Figure 3—Dense stand of young even aged trees, with a few remaining seed trees.

Uneven-aged stands

The uneven aged stands (15,232 acres) have three or more size-classes, with a little less than half in goshawk post-fledging family areas (PFA) and the remaining in foraging areas (FA). Currently these stands have higher densities and lack the desired size-class distribution or arrangement called for in the Forest Plan. These conditions are primarily the result of individual tree or small group selections and a lack of fire. This resulted in the establishment and survival of many young trees. These areas average about 500 trees per acre with an average tree diameter of 7.6 inches and a basal area of 113 square feet per acre (Table 2). The stand density index averages 245, which indicates that the site is fully occupied and competition-induced mortality is occurring with limited understory production. Those trees that survive only grow on average 2.3 inches in diameter over 40 years.

The existing canopy cover across the project landscape in the mid-aged forest (VSS4) is 32 percent and in the mature and old forest (VSS 5/6) it is 57 percent. Canopy cover is best attained at the clump and group stage, because stand canopy cover computation includes all the open areas.

The table below shows the current condition as a weighted average for PFAs and FAs in the uneven-aged stands. These stands are densely stocked with small trees and experiencing reduced vigor and tree growth in the larger trees. To increase tree vigor, improve tree growth and promote

healthy trees, there is a need to reduce stocking to the recommended levels of about 150 trees per acre. The resulting stands would be more resilient to the effects of periodic drought, disease, insect attack, and fire.

Table 2—Uneven-aged stand statistics for tree density, and size over time

YEAR	TREES/AC	BASAL AREA	AVE. DBH	SDI
2008	499	113	7.6	245
2028	437	133	8.7	273
2048	371	145	9.9	283

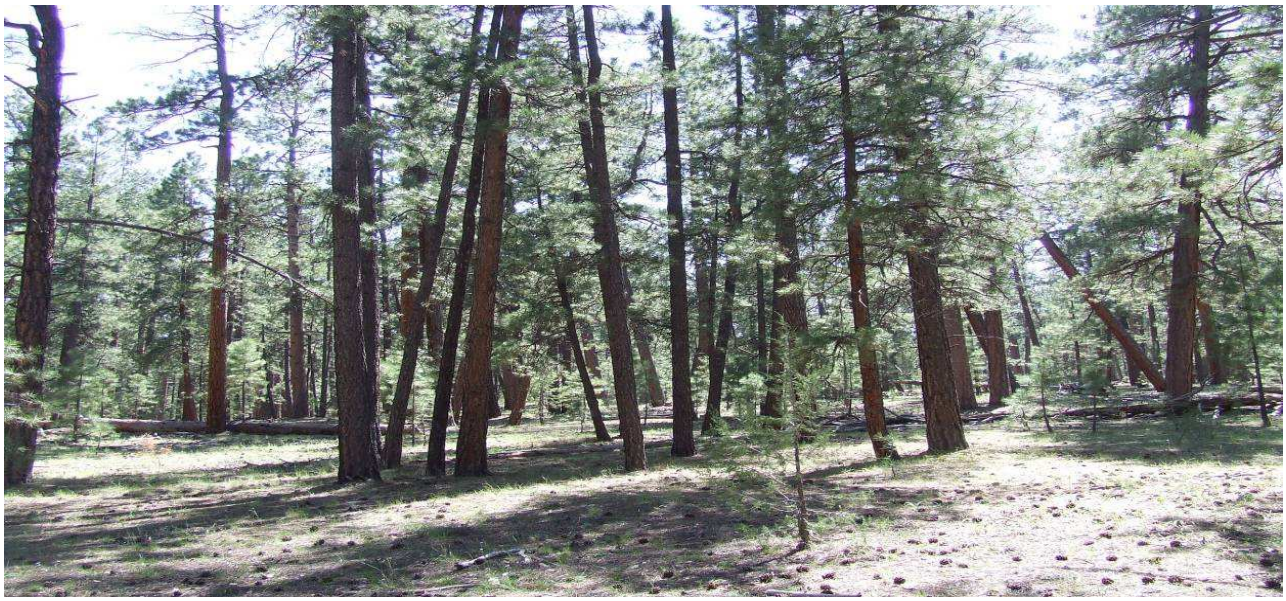

Figure 4—Uneven-aged stand with some large trees and desired groupings, but exceeding the desired density and the amount of ladder fuels

Goshawk Nest Areas

Replacement nest areas are identified when the PFA does not have six identifiable current or historic nest areas. Within the project area there are approximately 3,200 acres of identified nest areas plus an additional 1,000 acres identified as replacement nest areas. Currently, the nesting areas average more than 600 trees per acre and some of these trees are providing ladder fuels into the overstory crowns. The average tree diameter is 6 inches and basal area is 127 square feet per acre (Table 3). The stand density index averages 295 and along with the other information means that the site is fully occupied and competition-induced mortality is occurring. Uneven-aged stands that comprise the existing nest areas display similar characteristics to the replacement nest areas. There is a need to avoid stand-replacing wildfires to maintain this wildlife habitat and move the areas toward fire-adapted conditions. The table below shows the existing nest areas overtime with very high tree density and stocking levels.

Table 3—Tree densities and stand statistics in existing nesting areas

YEAR	TREES/AC	BASAL AREA	AVE. DBH	SDI
2008	609	127	6.0	295
2028	540	151	6.8	331
2048	460	166	7.8	348

The uneven-aged existing nest stands are currently in the self-thinning phase (mortality) of development due to competition between trees for available light, moisture, and nutrients. By 2028, mortality is still occurring and tree growth is extremely slow. The average tree diameter increases less than 1.0 inch in 20 years and less than 2.0 inches in 40 years. Tree mortality continues to increase through 2048 and puts these stands at risk from wildfire, insect attack, and disease. The probability exists that some kind of detrimental disturbance such as a wildfire could occur between now and 2048 if no corrective action takes place.

Dwarf Mistletoe

About 4 percent of the project area is infected with dwarf-mistletoe occurring in both even-aged and uneven-aged stands. Infected areas are widely distributed across the project and are treated as they occur as described in the background portion of this document (page 1).

Fire regime condition class

Fire regime condition classes measure the degree of departure from reference conditions, possibly resulting in changes to key ecosystem components, such as vegetation characteristics (species composition, structural stage, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances, such as insect and disease mortality, grazing, and drought. The three fire regime condition classes are categorized using the following criteria:

- FRCC 1 represents ecosystems with low (less than 33 percent) departure and that are still within the estimated historical range of variability during a specifically defined reference period;
- FRCC 2 indicates ecosystems with moderate (33 percent to 66 percent) departure; and
- FRCC 3 indicates ecosystems with high (greater than 66 percent) departure from reference conditions.

Possible causes of this departure include (but are not limited to) fire suppression, type and lack of timber harvesting, livestock grazing, introduction and establishment of exotic plant species, and introduced insects and disease. The overall rating for the Jacob-Ryan project area is 2 however, there are a few pocket areas categorized as 3.

Fire and Fuels Behavior

Fire and fuel conditions that currently exist in the analysis area are a result of past management activities such as the type and amount of tree harvesting and the amount of fuels accumulation brought about by limiting natural fire and aggressive fire suppression. These conditions include variables such as the amount of ladder fuels, fuel loading (tons per acre) and crown base heights (height of tree limbs from the ground) which is directly related to fire-flame lengths. Fuel loads on the ground within the project area have been estimated to range from 3 to 20 tons per acre by Southwestern Region photo series modeling (USDA 1996). Fuel loading is not evenly distributed across the project area and varies depending on previous vegetation management, as shown below:

- Pre-1980s cutting units range from 5 to 10 tons per acre.
- Shelterwood and seed-tree cutting units range from 3 to 7 tons per acre.
- Old lop and scattered thinning units range from 10 to 15 tons per acre.
- Areas prescribe burned in the recent past (1990s) range from 5 to 10 tons per acre.
- Untreated areas range from 10 to 20 tons per acre.

Table 4 below displays the existing condition for the other variables and demonstrates potential quantities if the conditions are not treated. The table is using existing PFAs in uneven-aged stands as an example because of their overall importance for goshawk habitat. Other areas such as nesting areas and FAs in both even-aged and uneven-aged stands, although not displayed, have quite similar numbers and would experience similar results. Exact quantification is difficult due to the varying amounts of available fuels, but close estimates are still possible. The data is showing that these stands are very over crowded, well over the recommended 150 trees per acre. Currently it would take a wind speed of about 42 mph to lift a fire into the stand crown and only about 14.5 mph to set off the tree crown of an individual tree. Of greater consequence is that with current fuel loading, the amount of ladder fuels and the number of trees per acre, a fire would have a ground flame length of almost 12 feet, which is already reaching over 3 feet into the existing canopy structure.

With successive 20 year increments without treatment, the number of trees is being reduced by self-thinning due to competition, but remains highly overstocked. Crown index wind speeds are dropping slightly and base canopy heights are increasing, but not sufficiently to be out of reach of fire flames from the ground. A stand ignition would likely result in a passive crown fire with pockets of active crown-fire according to the fire and fuels (FFE) model.

Table 4—Existing condition and representative variables for fire and fuel behavior

YEAR	TREES PER ACRE	CROWN INDEX WIND SPEED (mph)	TORCHING INDEX WIND SPEED (mph)	BASE CANOPY HEIGHT (feet)	FLAME LENGTH (feet)
2008	609	41.76	14.41	8.36	11.71
2028	540	37.23	18.43	8.47	12.80
2048	460	35.78	25.83	10.79	11.00

Desired Condition

Size-Class Distribution

The desired condition for GA 13 in ponderosa pine is an uneven-aged forest structure with an interspersed mosaic of tree groups (1/4 to 4 acres in size) representing the six vegetation structural stages (VSS) from open grass/seedling to old forest (Table 5). The desired arrangement has clumps of trees with interlocking crowns clustered, forming groups with irregular spacing. Table 6 takes the desired condition in number of trees per acre and breaks it out by PFA and FA habitat including the recommended basal area.

Table 5—Desired and existing distribution of vegetative structural stages for ponderosa pine forest types in the Kaibab National Forest Plan and Jacob-Ryan project area

Vegetative Structural Stage	VSS 1	VSS 2	VSS 3	VSS 4	VSS 5	VSS 6
Dominant Tree Diameter (DBH)	Less than 1”	1”-4.9”	5”-11.9”	12”-17.9”	18”-23.9”	24” over
Description	Grass/forbs and Shrubs	Seedlings Saplings	Young Forest	Mid-aged Forest	Mature Forest	Old Forest
Desired Area (%) In Each VSS	10	10	20	20	20	20
Existing Area (%) In Each VSS	4	4	19	19	29	25
Desired Trees Per Acre	61	36	26	13	10	7
Existing Trees Per Acre	190	198	65	20	13	7

Table 6—Minimum trees per acre (TPA) and basal area (BA) needed to attain the desired canopy cover and size-class distribution specified in the Kaibab National Forest Plan

Diameter Class (DBH)	VSS	Outside PFAs (FAs)		Within PFAs	
		Trees / Acre	Basal Area (feet/acre)	Trees / Acre	Basal Area (feet/acre)
Less than 1”	VSS 1	61	0	61	0
1”–4.9”	VSS 2	30	1	41	2
5”–11.9”	VSS 3	20	8	31	12
12”–17.9”	VSS 4	10	12	16	19
18”–23.9”	VSS 5	8	20	11	27
24” and over	VSS 6	6	23	8	30

Note: “0” basal area is called for in VSS 1 (seedlings) because basal area is measured at 4.5 feet in height (DBH).

Fuels and Fire Behavior

Table 7 presents the desired conditions in uneven-aged stands suitable for safely managing a low intensity surface fire.

Table 7—Desired conditions in uneven-aged stands to manage low-intensity surface fires

YEAR	TREES PER ACRE	FUEL LOADS (tons per acre)	CROWN INDEX WIND SPEED (mph)	TORCHING INDEX WIND SPEED (mph)	BASE CANOPY HEIGHT (feet)	FLAME LENGTH (feet)
2008	150	5 to 7	Greater than 20	Greater than 20	Greater than 20	Less than 4

- When fires occur, flame lengths are less than four feet in height, which allows direct attack strategies to be used.
- Tree groups are separated by openings that do not facilitate crown fires moving between groups.
- Prescribed fire and wildland fires burn through the area on an average of every 6 to 12 years, restoring the natural fire return interval.
- Dead and down fuel loading averages 5 to 7 tons per acre.
- Crown base height is generally greater than 20 feet.

Comparison of Existing and Desired Conditions

Below are comparison tables displaying the difference between the existing and desired condition. There is a need to reduce tree density, particularly in the smaller size-classes. Stand data for the uneven-aged stands in the project area show that existing forest structure does not have the desired size-class distribution: the grasses/forbs and seedling/sapling sizes (VSS 1 & 2) is 8 percent, when the desired condition is 20 percent, the young and mid-aged classes are in balance, and there is an abundance of mature and over-mature dominated groups (VSS 5 & 6) at 54 % when they should be around 40 %. Negative numbers indicate deficits. Positive numbers indicate the number of trees that exceed the desired minimum.

Table 8—Existing vs. desired condition in even-aged stands outside of PFAs (3,170 acres)

Tree-age by range of diameters	Vegetation Structural Stage (VSS)	Existing number of trees per acre	Desired number of trees per acre	Difference between existing and desired trees per acre
Less than 1”	VSS 1	57	61	-4
1”–4.9”	VSS 2	192	30	+ 162
5”–11.9”	VSS 3	35	20	+ 15
12”–17.9”	VSS 4	11	10	+ 1
18”–23.9”	VSS 5	5	8	- 3
24” and over	VSS 6	2	6	- 4

Table 9—Existing vs. desired condition in even-aged stands within northern goshawk PFAs (3,467 acres)

Tree-age by range of diameters	Vegetation Structural Stage (VSS)	Existing number of trees per acre	Desired number of trees per acre	Difference between existing and desired trees per acre
Less than 1”	VSS 1	40	61	-21
1”–4.9”	VSS 2	239	41	+ 198
5”–11.9”	VSS 3	38	31	+ 7
12”–17.9”	VSS 4	9	16	-7
18”–23.9”	VSS 5	4	11	-7
24” and over	VSS 6	2	8	-6

Table 10—Existing vs. desired conditions in uneven-aged stands outside of PFAs (8,026 acres)

Tree-age by range of diameters	Vegetation Structural Stage (VSS)	Existing number of trees per acre	Desired number of trees per acre	Difference between existing and desired trees per acre
Less than 1”	VSS 1	136	61	+ 75
1”–4.9”	VSS 2	213	30	+ 183
5”–11.9”	VSS 3	59	20	+ 39
12”–17.9”	VSS 4	22	10	+ 12
18”–23.9”	VSS 5	14	8	+ 6
24” and over	VSS 6	7	6	+ 1

Table 11—Existing vs. desired condition in uneven-aged stands inside PFAs (7,207 acres)

Tree-age by range of diameters	Vegetation Structural Stage (VSS)	Existing number of trees per acre	Desired number of trees per acre	Difference between existing and desired trees per acre
Less than 1”	VSS 1	190	61	+ 129
1”–4.9”	VSS 2	182	41	+ 141
5”–11.9”	VSS 3	70	31	+ 39
12”–17.9”	VSS 4	20	16	+ 4
18”–23.9”	VSS 5	13	11	+ 2
24” and over	VSS 6	6	8	- 2

Table 12—Existing vs. desired condition in northern goshawk nesting areas (3,205 acres)

Tree-age by range of diameters	Vegetation Structural Stage (VSS)	Existing number of trees per acre	Desired number of trees per acre	Difference between existing and desired trees per acre
Less than 1”	VSS 1	305	61	+ 244
1”–4.9”	VSS 2	209	41	+ 168
5”–11.9”	VSS 3	64	31	+ 33
12”–17.9”	VSS 4	16	16	0
18”–23.9”	VSS 5	12	11	+1
24” and over	VSS 6	7	8	-1

Proposed Action

The North Kaibab Ranger District, USDA Forest Service, proposes the following actions detailed in Chapter 2 in response to the purpose and need described above:

- Thin and convert even-aged stands to uneven-aged stands outside PFAs (3,170 acres)
- Thin and convert even-aged stands to uneven-aged-stands inside PFAs (3,467 acres)
- Thin uneven-aged stands outside PFAs (8,026 acres)
- Thin uneven-aged stands inside PFAs (7,207 acres) and enhance replacement nest areas
- Thin and enhance northern goshawk nest areas (3,205 acres)
- Treat dwarf-mistletoe infected trees as it occurs in above stands (see background-994 acres)
- Prescribe burn project area to initiate a fire-adapted landscape (about 26,000 acres)

The proposed action is separated into treatment types based on their different existing and desired conditions (see Figure 6). More specific detail regarding treatment types for each management area is found in Chapter 2. Figure 5 shows the desired outcome in an uneven-age stand.

Roads Analysis

The existing system of open and closed roads would provide adequate access to implement the proposal. No new road construction or reconstruction would be needed to access treatment units or stands. Any closed roads that are reopened temporarily to access timber treatment units would be closed following project completion. Some roads may be temporarily closed during project implementation as a public safety measure.

Figure 5—Uneven-aged stand showing desired tree grouping and open areas

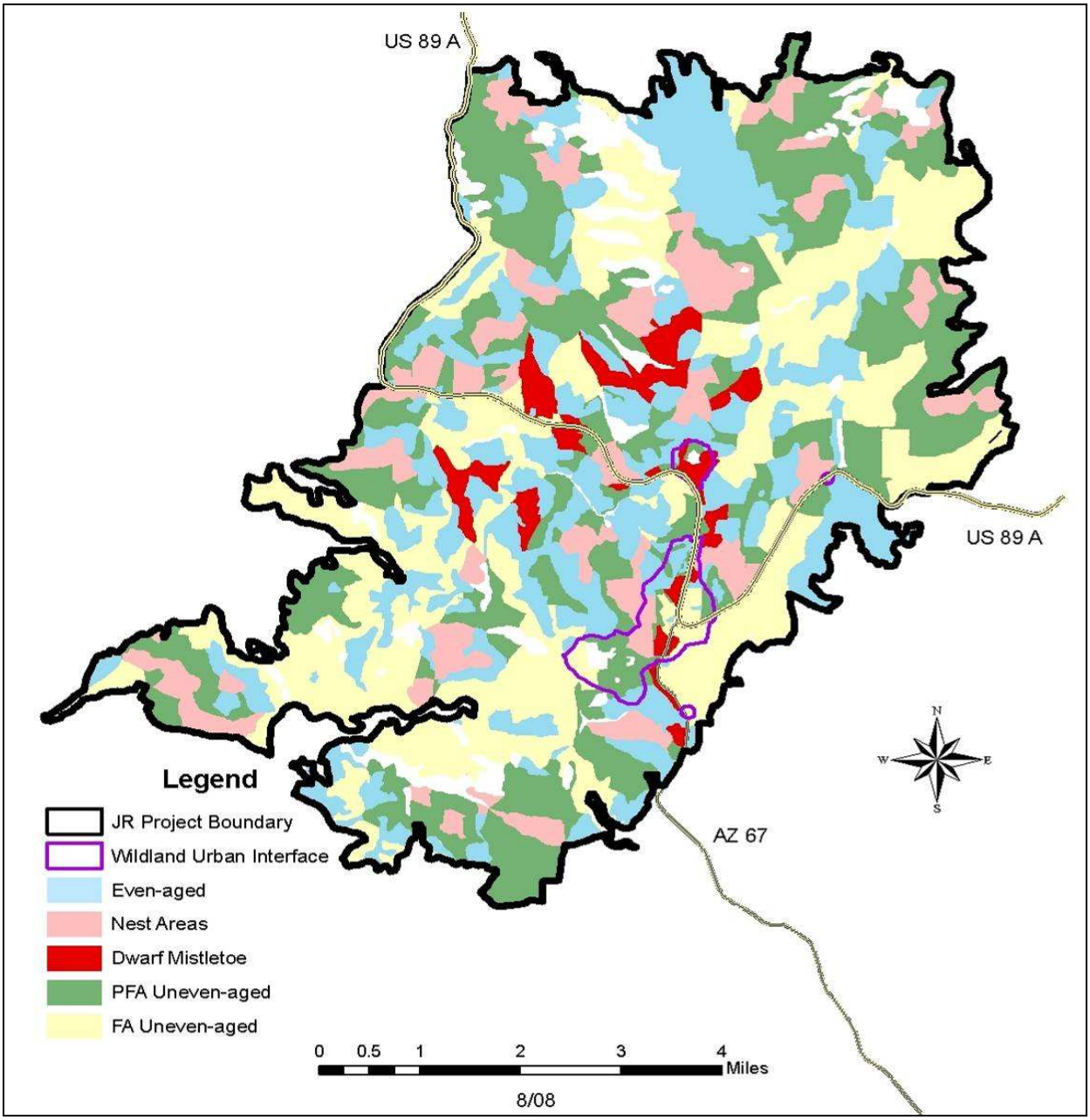

Figure 6—Jacob-Ryan existing condition and proposed treatment locations

Decision Framework

Given the purpose and need, the responsible official will review the proposed action, other alternatives, and potential impacts to resources based on the environmental analysis and decide:

- Whether to select the proposed action, no action, or an alternative;
- If an action alternative is selected, whether the alternative would be implemented as proposed, or as modified by actions within the scope of the analysis; and
- Whether the selected alternative would have significant effects requiring an EIS.

Public Involvement

A scoping letter and notice detailing the project proposal was distributed to interested parties on October 23, 2007 seeking public input and comments. The scoping notice was also posted on the Kaibab National Forest web site with a request for comments.

Five comment letters were received following the fall 2007 scoping notice. A list of issues and alternatives were developed using the comments received from the public scoping notice for this project. Responses to all comments can be found in the project record (PR 53, 57, 59, 60 and 61 and Appendices G and I).

Team members discussed the proposed action, issues, and potential alternatives with a range of stakeholders including the Arizona Game and Fish Department, Arizona Department of Transportation, Arizona Department of Environmental Quality, Grand Canyon Trust, Center for Biological Diversity, Grand Canyon Wildlands Council, Sierra Club, Ecological Restoration Institute, Navajo Tribe, Kaibab-Paiute Tribe, and Hopi Tribe. Comments from these meetings were considered and incorporated into the analysis and development of alternatives.

Issues

The interdisciplinary team sorted comments into issues and non-issues. An issue is a point of disagreement, debate or dispute over the proposed action based on environmental effects. Non-issues are all those general concerns received through scoping that are not related to current proposed action effects. Significant issues are issues that warrant further study and response. Significant issues were addressed through modification of the proposed action, development of design and mitigation criteria, or development of new alternatives. Non-significant issues are those that are (1) outside the scope of the proposed action; (2) already decided by law, regulation, Forest Plan or other higher level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence.

Three significant issues were identified:

1. Cutting trees larger than 12 inches DBH may negatively affect wildlife habitat and old growth and result in a lost opportunity to develop additional old growth.

   Response: Although the proposed action would remove some trees in the 12 to 18 inch size-class, the remaining trees over 12 inches would be less stressed, have higher growth rates, and be less susceptible to loss in the event of a wildfire, which is expected to better provide for future VSS5 and 6 groups. In response to this concern, an alternative was developed and analyzed in detail that would not cut any trees over 12 inches.

2. Heavy equipment used during thinning activities would cause soil disturbances, compaction, and erosion problems.

   Response: Areas containing steep and unsatisfactory soils were withdrawn from the project area. Project-specific mitigation measures were developed for areas with sensitive soils. No new construction or reconstruction of roads is proposed. Existing skid trails would be used. Use of soil and watershed best management practices would minimize adverse impacts to soils.

3. During implementation there would be unanticipated mortality of some large trees, resulting in fewer large trees than desired.

   Response: Following the writing of the site prescription for mechanical and prescribed burning treatments, the prescribed burn is modeled to take into account incidental tree mortality. Precautions are taken so as not to remove more than the recommended number of trees including unanticipated mortalities. Additionally, implementation and effectiveness monitoring is part of this proposal. If, during the initial phases of implementation, higher mortality than expected occurs, adjustments would be made during the subsequent implementation phases so that additional trees are left in the 12- to 18-inch size class as replacement trees.

Table 13—Non-significant issues and concerns and associated rationale

Non-significant issues and concerns	Rationale For Non-Significance
The proposed action does not specify road closures or increase inventoried roadless areas to benefit wildlife habitat or reduce the miles of road per square mile.	Outside the scope of the proposed action. Analysis and recommendations related to roads on the District will be addressed in the North Kaibab Travel Management analysis.
The proposed action impacts all wildlife populations and habitats, especially threatened and endangered (T&E) species, as well as sensitive and management indicator species (MIS).	Conjectural and not supported by scientific or factual evidence. No T & E species populations or habitat are within the project area. Effects to sensitive and MIS species are analyzed and disclosed in the Wildlife section in Chapter 3. Activities follow goshawk guidelines in the Forest Plan.
The proposed action impacts all wildlife populations and habitats, especially after the losses incurred from the 2006 Warm Fire	Conjectural and not supported by scientific or factual evidence. The Proposed Action protects old growth as well as initiates and advances a fire-adapted landscape to help prevent a similar occurrence.
The proposed action creates soil disturbance by constructing and reconstructing roads to mechanically thin timber stands.	Irrelevant to the decision to be made. No new construction or reconstruction of roads is included in the proposed action. Existing skid trails would be used. Use of BMPs and S & Gs minimize impacts to soil resources.
The proposed action does not use the MASS model developed during the previous Jacob-Ryan Project to protect and develop additional old-growth trees.	Conjectural and not supported by scientific or factual evidence. MASS model does not meet or approach the desired condition for vegetation management set forth in the Forest Plan. An additional explanation for non-use is found in Appendix G.
The proposed action does not address the introduction of invasive plant species as the result of mechanical thinning or prescribed burning.	Conjectural and not supported by scientific or factual evidence. Monitoring and invasive weed treatment before, during, and after implementation is a standard management practice and is included by inference as part of the proposed action. It is also covered in the region-wide Programmatic EIS for invasive weed species.
The proposed action does not address potential livestock grazing impacts to vegetation recovery during and following mechanical and prescribed fire treatments.	Already decided by law, regulation, Forest Plan or other higher level decision. Potential livestock impacts are considered within the context of cumulative effects in Chapter 3. Mechanically treated units are rested at least one year before burning and two years after burning to allow for suitable vegetation recovery.

CHAPTER 2 – ALTERNATIVES

This chapter describes the alternatives considered for the Jacob-Ryan Project and presents them in comparative form. These alternatives address the significant issues identified in Chapter 1. The 18 inch diameter cutting limit specified in the Proposed Action is a voluntary constraint for biological reasons. It is offered as a means to conserve and encourage the development of more mature and old trees that would help offset the existing deficit for these age classes in Geographic Area 13. Both action alternatives are designed to make progress towards the desired uneven-aged structures and reduce the risk of stand-replacing fires specified in the Kaibab Forest Plan. However, the cutting limits are critical when measuring the effectiveness and the speed in reaching the Forest desired condition. The maximum tree diameter to be cut in this entry (18 verses 12 inches DBH) is the only difference between the two action alternatives. When approved a combination of (1) stewardship contract(s), (2) commercial timber sale(s), (3) service contract(s) and/or (4) Forest Service crews would be used to implement the treatments.

Alternative 1 – No Action

Under the no-action alternative, no mechanical vegetation treatments or prescribed burning would occur. There would be no fuels reduction and no progress toward the desired VSS distribution specified in the Forest Plan and would not meet the purpose and need of the project. This alternative complies with the National Environmental Policy Act requiring a no-action alternative be evaluated and analyzed as a basis for comparison.

Alternative 2 – Proposed Action

The proposed action for the Jacob-Ryan Project would use mechanical tree thinning and prescribed burning to reduce ponderosa pine tree density, fuel loading and achieve or make progress towards the desired tree size-class distribution. The proposed action is divided into treatment areas based on their different existing and desired conditions outlined in Chapter 1.

Even-aged Stands Outside Goshawk PFAs (3,170 acres)

To achieve the desired diameter distribution, thin trees up to 18 inches in diameter, leaving groups of trees in the VSS classes 4, 5, and 6. Thin between clumps of trees to open up the rooting zones and increase moisture and nutrient availability. Thin within some groups to reduce ladder fuels and competition, and to promote faster diameter growth so that some of the smaller over-represented size groups may develop more quickly into the larger under-represented classes. Create some areas for VSS 1 replacements by removing some VSS 2 and 3 groups. These openings are needed to provide for tree regeneration and the desired size-class distribution. Maintain current and manage for future canopy cover of at least 40 percent in VSS 4, 5, and 6 groups. Due to previous management strategy, these areas lack the desired groups of VSS 5 and 6 trees. Follow-up thinning treatments would be needed at approximately 20 and 40 years to maintain faster diameter growth and promote the development of VSS 5 and 6 groups.

Even-aged Stands Within Goshawk PFAs (3,460 acres)

To achieve the desired diameter distribution, thin trees up to 18 inches in diameter leaving groups of trees in the VSS classes 4, 5, and 6. Open up the rooting zones by thinning between clumps of trees to increase moisture and nutrient availability. Promote better diameter growth and future desired structure by thinning within some tree groups. Remove some VSS 2 and 3 groups (convert to VSS 1) to create the desired size-class distribution and group sizes. Maintain current and

manage for future canopy cover at 50 to 60 percent in VSS 4, 5, and 6 groups. Due to previous management strategy, these areas also lack the desired groups of VSS 5 and 6 trees. Follow-up thinning treatments would be needed at approximately 20 and 40 years to maintain faster diameter growth and promote the development of VSS 5 and 6 groups.

Uneven-aged Stands Outside Goshawk PFAs (8,026 acres)

These areas currently have three or more size-classes, but generally have higher tree densities than desired and do not have the desired clumpy/group arrangement. Treatments would thin smaller sized trees up to 18 inches DBH to enhance and promote the desired arrangement and distribution of VSS groups within the stands. Although the average trees per acre exceed the desired condition in the smaller-sized trees, many of those trees are scattered within groups of larger trees. In some areas it may be necessary to remove some clumps and groups to create openings that encourage VSS 1 replacements and provide space for existing VSS 1 trees to transition into VSS 2 groups. Create or maintain conditions within tree groups so trees form clumps with interlocking canopies so that VSS 4, 5, and 6 groups average at least 40 percent canopy cover. Create or enhance open areas between groups for root growth and access to nutrients and moisture. Thin to reduce ladder fuels and reduce the potential for stand-replacing wildfire.

Uneven-aged Stands Within Goshawk PFAs (7,200 acres)

Thin from below for trees up to 18 inches DBH to reduce tree density and continue the development of structural groups within stands. Maintain or create conditions within groups so that trees form clumps with interlocking canopies. Create or enhance open areas between groups and stands for root growth and accessibility to nutrients and moisture. Maintain current and manage for future canopy cover at 50 to 60 percent in VSS 4, 5, and 6 groups.

Goshawk Nest Areas (3,205 acres)

Maintain canopy cover between 50 and 60 percent so that many trees form clumps with interlocking canopies. In existing and suitable nest areas, focus thinning to raise crown base height to reduce the potential for undesired tree mortality following fire. In nest areas where VSS 5 and 6 groups are lacking, thin from below in some of the VSS 4 groups to promote the development of VSS 5 and 6 groups with interlocking crowns. Implement BMPs to minimize human disturbance and maintain satisfactory soil conditions. Conduct project-related activities outside the breeding season, March 1 to September 30. Once excessive fuel loading and ladder fuel conditions are corrected, fire is the preferred tool to maintain desired conditions over time.

Prescribed Burning (acres)

Prescribed burning is needed across most of the project area in order to reduce the dead and down fuel loads, reduce flame lengths and raise crown base height of trees as outlined in Chapter 1. Some areas would be thinned and then burned, some would be thinned and followed with pile burns (where high fuel loads exist), while some areas would be burned and then thinned only if needed.

Generally, prescribed burn treatments are initiated one to five years following mechanical treatments. The timing of the burns would vary to achieve desired conditions. Prescribed burns may be delayed or excluded in young pine stands when the potential for mortality and loss of smaller trees groups would not meet the desired size-class distribution. The table below uses some uneven-aged stands in PFA areas to forecast fuel conditions and fire behavior variables following

Proposed Action mechanical treatments and prescribed burning. Prescribed burning takes place 5 years after mechanical treatment in this example.

Table 14—Fuel conditions and fire behavior variables after Proposed Action treatments

	FUEL LOADS (tons per acre)	CROWN INDEX WIND SPEED (mph)	TORCHING INDEX WIND SPEED (mph)	BASE CANOPY HEIGHT (feet)	FLAME LENGTH (feet)
Existing	3 - 20	41.76	14.41	8.36	11.71
Mechanical	10 - 30	53.58	37.72	16.18	7.48
Burning	5 - 7	55.96	37.69	25.66	7.81

It is important to note that wind speeds have to increase almost 15 mph over existing conditions to escalate a ground fire into the crown following both mechanical treatments and prescribed burning, and the torching index wind speed for individual trees has to increase over 23 mph. Equally important is the change in the base canopy height (distance from the ground to the lowest tree branches). It has been raised to over 25 feet while the flame length has dropped to less than 8 feet with the remaining fuel loads. This is a substantial first step in reducing fire hazards as well as fire risk across the project landscape.

Due to the road density in the area, existing roads and natural features would be used to control prescribed burns. Some fire lines may be constructed to connect existing fuel breaks and would follow soil and watershed BMPs for ground-disturbing activity, and receive heritage clearance prior to fire line construction.

Alternative 3 – Twelve-Inch Diameter Limit

This alternative was developed in response to significant Issue 1 raised during the public comment period that cutting trees larger than 12 inches in diameter may negatively affect wildlife habitat and result in lost opportunities to develop additional old growth. The only difference between this alternative and the proposed action is that Alternative 3 would only thin trees up to 12 inches in diameter. All other management specification would be the same.

The table below uses the same uneven-aged stands in PFA areas and time frames as above to forecast fuel conditions and fire behavior variables following mechanical treatment and prescribed burning in Alternative 3.

Table 15—Fuel conditions and fire behavior after Alternative 3 treatments

	FUEL LOADS (tons per acre)	CROWN INDEX WIND SPEED (mph)	TORCHING INDEX WIND SPEED (mph)	BASE CANOPY HEIGHT (feet)	FLAME LENGTH (feet)
Existing	3 - 20	41.76	14.41	8.36	11.71
Mechanical	7 - 25	49.76	33.68	15.68	7.80
Burning	5 - 7	52.48	38.00	24.65	7.73

In this example wind speeds have to increase almost 11 mph over existing conditions to escalate a ground fire into the crown following both mechanical treatments and prescribed burning while the torching index wind speed for individual trees remains the same as in the Proposed Action. The base canopy height increases to over 24 feet while the flame length after treatments remains essentially the same. Again, this also is a substantial first step in reducing fire hazards as well as fire risk across the project landscape, but the remaining trees are still overcrowded requiring additional entries to reach the desired condition.

Mitigation Measures for Action Alternatives

Mitigation measures are developed in response to issues and concerns raised during proposal development to avoid, minimize or compensate for actions anticipated to have adverse effects. The following project-specific mitigation measures were identified:

- No trees over 18 inches DBH would be cut during this project.
- No presettlement trees, regardless of size, would be cut during this project. Presettlement trees are those trees with characteristics indicating they are more than 130 years old (yellowish, mosaic plating bark, straight boles and flat tops).
- With the exception of some pile burning of activity created fuels, prescribed burning would be initiated at least a year following mechanical treatments.
- Skid trails and fire lines located in TES map units 294, 298, 620, and 624 will have water bars constructed by hand where excessive slope prevents improper water bar construction by machine.
- No log landings or decking areas will occur on slopes exceeding 15 percent in TES map units 294, 298, 620 and 624.
- No machine piling of slash or log landings will occur in TES map unit 9.

Monitoring for Action Alternatives

The following monitoring activities would be conducted for any of the action alternatives:

- Survey for and treat invasive weed species before, during, and after project implementation.
- Monitor implementation during and after project completion for compliance with project specifications, particularly erosion control measures associated with burning and harvesting operations.
- Host a monitoring field trip with project commenters and stakeholders after the first phase of implementation to obtain feedback in time to make adjustments prior to project completion.
- Monitor unintended mortality caused during implementation so that treatment prescriptions may be adjusted to maintain the desired forest structure.
- Follow up after five years to monitor effectiveness of erosion control measures for skid trails, log landing or decking areas, road maintenance, and burned areas.

Best Management Practices (BMP)

In addition to project-specific mitigations, project implementation will use best management practices commonly applied for these types of activities to prevent resource impacts. These come from a number of sources including the Kaibab Forest Plan, Forest Service Handbooks and Manuals, and interagency agreements. A detailed list of BMPs is included in Appendix H. Key BMPs by resource are listed below:

Silviculture

- Interlocking canopy structure: Maintaining existing canopy structure during the creation or restructuring of clumps and groups of trees within stands to protect resident wildlife habitat.
- No openings larger than 4 acres would be created.

Fire and Fuels

- A prescribed fire burn plan would be prepared for each unit utilizing the interagency prescribed fire burn plan template and in accordance with silvicultural and range management prescriptions and submitted to the state DEQ for approval.
- Other than the burning of slash piles or broadcast burning when there is no mechanical treatments, prescribed burning would not be implemented in the same year as mechanical treatments.
- Mechanical units would be evaluated annually to ensure that follow up prescribed burning does not create more mortality than stated for the desired condition.
- Schedule burns to avoid weather conditions that would impact smoke sensitive areas and create excessive smoke particulate emissions.

Soils and Watersheds

- No machine harvesting activities would occur in ephemeral stream channels, meadows, or narrow alluvial plains and on steep slopes (>30 %).
- Limit all ground-disturbing mechanized activities (tractor skidding, decking, machine piling, etc.) to periods when soils are dry or frozen to minimize soil compaction and displacement (rutting, etc).
- Conduct broadcast burns when moisture and temperature conditions are suitable for burning in a manner that reduces fuels while maintaining or improving effective ground cover levels to prevent soil loss from exceeding tolerable soil loss limits.
- Reseed severely burned areas with a native grass species that is effective in controlling erosion. Consider spreading unburned slash over severely burned reseeded areas.
- Roads will be maintained throughout the mechanical thinning portion of the project to ensure that drainage structures (rolling dips, culverts, rock crossings, etc.) are functioning correctly and lead-out ditches are maintained in a manner that does not allow sediment-laden runoff to enter stream courses and/or drainages.
- To maintain or improve long-term soil productivity, manage towards a minimum of 5 to 10 tons/acre of coarse woody debris.

Wildlife

- Machine piling of activity fuels would not be conducted in nesting areas.
- Project-related disturbance will not occur inside active goshawk PFAs from March 1 to Sept 30.
- Condor conservation measures and bald eagle protection guidelines will be followed.
- Protect and retain at least two snags (18 inches in diameter and 30 feet high) and three large down logs per acre (over 12 inches at the midpoint and at least 8 feet long).

Heritage Resources

Heritage resource sites will be flagged for avoidance prior to project implementation. *No ground disturbance will be permitted within flagged boundaries. Prescribed burning will be permitted at non-fire-sensitive sites. Piling of slash, pile burning or broadcast burning of slash will not be authorized on top of known sites.* In the event that an undocumented site is located during

implementation, activities will cease and the North Zone archaeologist will be contacted to assess and complete any needed legal consultation.

Range and Invasive Species

- Following prescribed burns, livestock grazing will be deferred for at least two years.
- Noxious weeds will be inventoried and treated inside the project area before, during, and after project implementation. In areas where high infestations of aggressive invasive species are found, planned activities will be delayed until the species is treated and controlled.
- Prevention activities to minimize invasive species introduction are outlined in the best management practices in the EIS for the *Integrated Treatment of Noxious or Invasive Weeds 2005* and would be followed during all aspects of project implementation

Visual Quality and Recreation

- Mark trees on the side facing away from road within 200 feet of the road edge and within 50 feet of the trail edges.
- If "leave" trees are marked, use butt mark only within 200 feet of the road and 50 feet of trail edges, and mark on the side facing away from the road or trail.
- Sign trails/trailheads to advise the public of vegetative or prescribed burning treatments, schedules, and/or closures.

Alternatives Considered but Eliminated from Detailed Study

The alternatives below were considered but eliminated from detailed study for the following reasons.

Comprehensive Implementation Alternative

Thin to achieve the desired forest structure in the Forest Plan without diameter cutting limits, which would allow for some trees to be cut over 18 inches DBH. This alternative would achieve the following:

- More closely achieve the desired size-class distribution.
- More effectively treat dwarf-mistletoe infected trees and stands.
- Create more open areas between tree groups for nutrient and moisture uptake, as well as provide for more understory plant development and regeneration of seedling trees.
- Better protect wildlife habitat from high-intensity stand replacing wildfires.
- Result in more merchantable wood to be cut than the proposed action (125,094 CCF vs. 48,487 CCF) or Alternative 3 (12,922 CCF). This would make the project more economical and better offset the cost of project implementation.

This alternative was evaluated but not carried forward for this entry as a means to conserve and increase in number the amount of mature and old trees in Geographic Area 13 by limiting vegetation management to trees less than 18 inches DBH.

Alternatives with 14- and 16-inch Diameter Cutting Limits

These intermediate diameter cutting limits were considered but eliminated from detailed study because Alternative 3 and the Proposed Action represent a range of alternatives above and below these suggested diameter limits. These diameter limits are therefore within the range of the alternatives analyzed. Development and analysis of intermediate diameter limit alternatives would not expand the range of alternatives.

Comparison of Alternatives

The following table compares the three alternatives analyzed in detail, including key actions to be taken, key results, and key environmental effects.

Table 16—Comparison of Alternatives

Project Activity and Effects	Alt. 1	Alt. 2	Alt. 3
Vegetation Management (acres approximate)			
Acres to be treated	0	26,000	26,000
Even-aged stand treatment	0	6,636	6,636
Nesting area treatment	0	3,205	3,205
Dwarf-mistletoe treatments (as it occurs)	0	950	950
Uneven-aged PFA treatment	0	7,207	7,207
Uneven-aged treatment outside PFA	0	8,026	8,026
Maximum tree diameter to be cut (BDH)	0	17.9”	12.0”
Potential commercial saw-timber removed (CCF)	0	48,487	12,992
Fire and Fuels			
Prescribed burning (acres-approximate)	0	26,000	26,000
Flame Length (feet)	12.0	7.8	7.8
Fuels Loading (tons per acre)	3 to 20	5 to 7	5 to 7
Base Canopy Height (feet)	8.7	25.7	24.7
Fire regime condition class after treatments	2 and 3	1 and 2	2
Soil and Watershed			
Soil and watershed condition after treatments	Unchanged	Satisfactory	Satisfactory
Visual Quality and Recreation			
Meets visual quality objectives.	Yes	Yes	Yes
Meets recreation opportunity spectrum.	Yes	Yes	Yes
Wildlife Habitat			
Affects Mexican spotted owl habitat.	No	No	No
Affects California condor	No	No	No
Landscape Affect			
Moves project area towards a fire-adapted landscape	Continued high risk of stand replacing wildfires	Reduces fuel loading and potential fire risk	Reduces fuel loading but not as much as Proposed Action

CHAPTER 3 – ENVIRONMENTAL EFFECTS

The Jacob-Ryan Vegetation Management Project consists of approximately 26,000 acres in the north-central portion of the Kaibab Plateau, Kaibab National Forest, Arizona. This section summarizes the physical, biological, social, and economic environments of the affected area and the potential changes to those environments due to implementation of the alternatives. It provides the scientific and analytical basis for the comparison of alternatives presented in Chapter 2.

Silviculture

Affected Environment

Ponderosa pine is the dominant vegetation type across the project area and exceeds 90 percent of the vegetative cover. Currently, there are about three times as many trees as desired, and most are less than 5 inches diameter breast height (DBH). These saplings and poles can act as ladder fuels, carrying fire into the overstory. Trees growing at higher densities are slower growing, more susceptible to insect and disease, and at risk of loss due to uncharacteristic wildfire (see Silviculture and Fuels Specialist Reports-PR 41 & 44).

Prior to Euro-American settlement, frequent surface fires helped maintain open park-like stands (Covington and Moore 1994). Before settlement, frequent fire return intervals ranging from 2 to 12 years maintained the ponderosa pine forest in a pine/grass habitat type. Grass and brush carried fire throughout the stand with mosaic burn patterns. Historically, young trees survived only in protected micro sites, and developed in clumps.

Timber harvesting, livestock grazing, and fire exclusion created conditions that facilitated pine regeneration well above historic levels. Timber harvesting on the North Kaibab Ranger District dates back to the late 1800s. Heavy selective harvesting was conducted around the historic Jacob Lake Ranger Station. There were at least three timber harvests in the project area between the end of World War II and the early 1980s. These timber harvests focused on stand improvement and increasing the yield of saw timber. The removals were mostly large trees likely to die before the next entry, including trees that were "over mature," had poor form, or were infected with dwarf-mistletoe. This type of harvest was commonly referred to as individual tree selection or improvement selection (Pearson 1950).

From the mid-1980s until 1996, the timber management strategy shifted from stand improvement to shelterwood seed-tree regeneration treatments that promoted an even-aged forest structure. These timber management units were smaller, but the per-acre timber volume harvested was greater. Even-aged management combined with fire exclusion resulted in very dense even-aged stands in these areas.

Approximately 25 percent of the project area is even-aged as a result of past shelterwood seed harvests. These stands are dominated by a continuous growth of trees less than 12 inches in diameter that lack any stand openings. There are a few large older trees that had been left as seed trees. These even-aged stands average 450 trees per acre, with a mean tree diameter of 5.1 inches DBH and an average Stand Density Index (SDI) is 132 (Table 1-Chapter 1). This rating indicates the stand is heavily overstocked with trees and that there is competition between individual trees for water, nutrients, and growing space. Understory productivity in grasses and forbs is relatively low due to tree density.

Within the project area there are approximately 3,200 acres of identified goshawk nest areas plus an additional 1,000 acres identified as replacement nest areas. Replacement nest areas are

identified when the PFA does not have six identifiable current or historic nest areas. The nesting areas currently average more than 600 trees per acre. These trees are averaging 6 inches in diameter, have a basal area of 127 square feet per acre and a stand density index averaging 295 (Table 3-Chapter 1). This means that the site is fully occupied and competition-induced mortality is occurring. Understory productivity in grasses and forbs is very low due to high tree density.

There are approximately 1,000 acres or 4 percent of the project area infected with dwarf-mistletoe. It occurs in both even-aged and uneven-aged stands. Mistletoe infected areas are widely distributed across the project and are generally patchy in nature with discrete infection centers. Mistletoe infected trees in this project are treated as they occur within the larger context of the overall stand (Chapter 1-page 1). Left untreated these trees experience reduced growth and a high rate of mistletoe-related mortality that prevents the development of the desired forest structure.

To increase tree vigor, improve tree growth, and promote the development of VSS 5 and 6 groups, there is a need to reduce competition. Healthier forests are also more resilient to the effects of periodic drought, disease, insect attack, and fire.

Direct and Indirect Effects

Alternative 1 – No Action

Under the no-action alternative, neither mechanical thinning nor prescribed burning would occur. The trees in the project area even-aged stands are competing with each other for limited moisture, nutrients, and light. These stands were modeled using the Forest Vegetation Simulator (FVS). When modeled over time, these stands would grow slowly from about 5 inches to less than 9 inches DBH after forty years (Table 17). In their weakened condition, they grow slower and are more susceptible to infestations by bark beetles and dwarf-mistletoe. The desired condition for each category is in parentheses. Progress towards creating or enhancing uneven-aged site conditions would not occur. These areas are highly susceptible to insect and disease and loss due to uncharacteristic wildfire (see Silviculture & Fuels Specialist Reports-PR 41 & PR 44). With no action, these stands would have more than twice the recommended stand density after 40 years and understory production would continue to decline.

Table 17—Current even-aged and projected future stand statistics

Year	Trees/Acre	Basal Area	Ave. DBH	SDI*
2008	448 (153)	55.5 (90.0)	5.1 (10.0)	132 (160)
2028	402	90.0	7.1	193
2048	347	120.0	8.9	237

*Average desired conditions are included in parentheses for comparison

Table 18 below illustrates that the number of trees per acre in the uneven-aged stands would overtime continue to exceed the desired condition, but competition between trees would result in some mortality over the next 40 years and fewer trees per acre. The basal area per acre would increase, but without treatment would grow slowly from about 7.6 inches to 9.9 inches DBH. Over time, these stands could become more even-aged due to a lack of regeneration and recruitment of seedlings and saplings.

Table 18—Current uneven-aged (PFA & FA) and projected future stand statistics

Year	Trees/Acre	Basal Area	Ave. DBH	SDI*
2008	499 (160)	113.0 (100.0)	7.6 (17.0)	245 (180)
2028	437	133.0	8.7	273
2048	371	145.0	9.9	283

*Average desired conditions are included in parentheses for comparison

Very dense stands usually have thick needle cast that does not allow for seedlings to become established and closed canopies that do not provide enough light for ponderosa pine seedlings to survive.

The no action alternative would keep the project area susceptible to high intensity stand-replacing fire. If a stand-replacing fire occurs, the area could transition from a forested landscape to an uncharacteristic brush- or shrub-dominated community. Burned areas are also highly susceptible to invasive weed-species. This could have already occurred to some degree in the adjacent Warm Fire burn area where almost 70 percent of the burned land is in grasses and shrubs (VSS 1). This community-type conversion could take hundreds of years to return to pre-fire conditions.

The existing goshawk nest areas are also in the self-thinning state, growing at about 295 SDI, 65 percent of maximum (Table 19). Competition between trees for available light, moisture, and nutrients is causing tree mortality. Incrementally by 2028, mortality would continue to occur as basal area and SDI increase and diameter growth decreases. This self-thinning would continue to increase through 2048 when the average SDI is estimated to be 348 or 77 percent of maximum. These stands are at risk of loss from wildfire, insect attack, and disease. It is probable that some disturbance such as a wildfire would occur between now and 2048 if no action takes place.

Table 19—Current and projected future tree density stand statistics in nest areas

Year	Trees/Acre	Basal Area	Average DBH	SDI
2008	609 (180)	127 (100.0)	6.0 (18.0)	295 (190)
2028	540	151	6.8	331
2048	460	166	7.8	348

* This table is a duplicate of Table 3-Chapter 1 placed here for emphasis

Under the no-action alternative, older trees with mistletoe would continue to infect understory ponderosa pine trees and then eventually die. The younger, infected trees would be more stressed and susceptible to insect infestation or drought. Over time, heavily infested areas would have a lot of dead trees in the overstory with an understory dominated by shrubs, grass, and forbs and some infected smaller trees. Figures 7 and 8 illustrate anticipated changes in a mistletoe-infested stand using the Stand Visualization System (SVS - Forest Vegetation Simulator models) in 2008 and in 2058 without treatment. Mortality would occur in both small and large trees, and as a result, the desired condition would not be achievable or sustainable. Over time, these areas may convert to brush/grass sites.

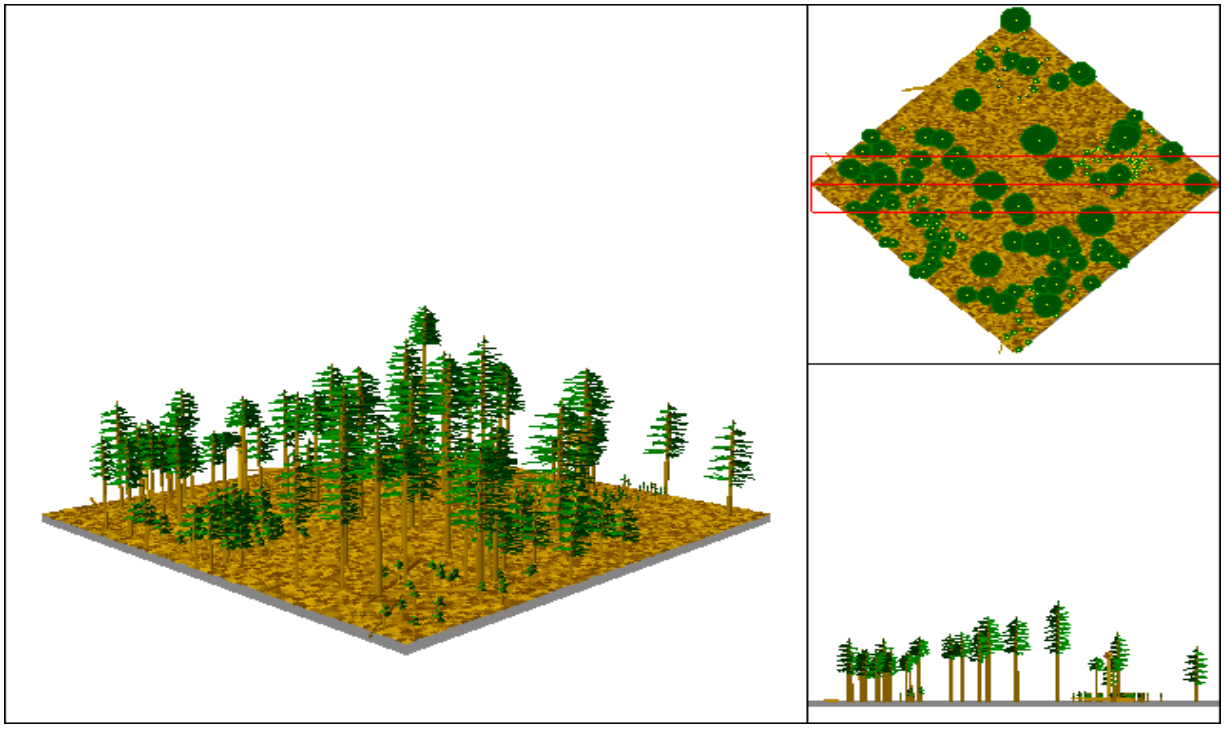

Figure 7—Representative stand with dwarf-mistletoe infected trees; 2008

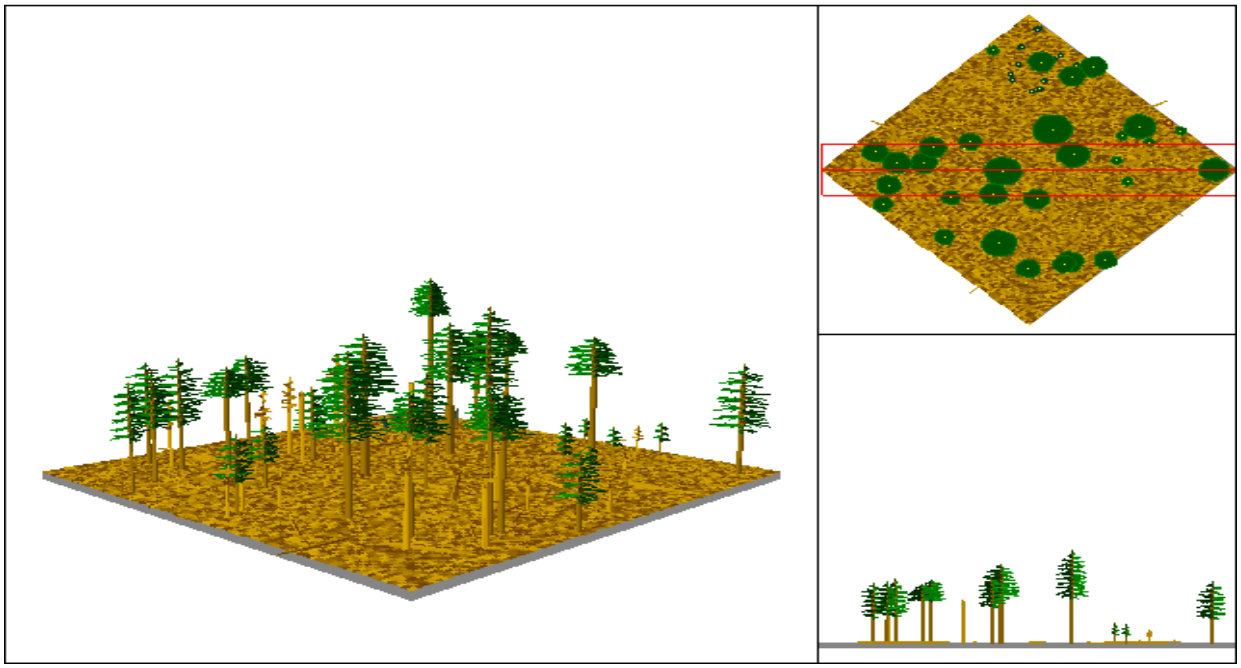

Figure 8—Representative mistletoe stand grown for 50 years with no treatment

Alternative 2 – Proposed Action

The proposed action would use mechanical thinning to reduce tree density and make progress towards achieving the desired size-class distribution. The residual trees would have more light, moisture, and nutrients for increased growth. They would also be more similar to the historic pattern of age, size, and structure, and the understory would be more abundant and diverse.

Currently the uneven-aged areas have an abundance of trees in the smaller diameter size that are less than 12 inches DBH. In order to achieve the desired size-class distribution called for in the Forest Plan, these areas would be thinned to promote and enhance groups of trees in differing size classes. The proposed action would thin trees up to 18 inches DBH, leaving all large, mature and old trees. This may result in some areas retaining more VSS 5 than desired and some deficits in VSS 1 and VSS 2, but it would be making progress toward desired conditions.

The even-aged stands currently have an excess of trees that are less than 12 inches DBH. The proposed action would thin these areas to create groups and thin within some groups to promote better diameter growth and future desired structure. Some openings would be created (VSS 1) by removing groups of trees in VSS 2, 3, and 4 to achieve the desired size-class distribution and group sizes. This alternative would also thin between clumps of trees to open up the rooting zones and increase moisture and nutrient availability. Follow-up thinning treatments would be needed at approximately 20 and 40 years to maintain faster diameter growth and promote accelerated development of VSS 5 and 6 groups.

FVS modeling was done for the proposed action on different representative stands. Modeling of an uneven-aged replacement goshawk nest stand showed that the projected average diameter would double over the next 40 years. The projected average diameter in one of the even-aged stands showed that under the proposed action the average diameter would almost triple over the next 40 years (Silviculture Report-PR 41). This dramatic increase in average diameter would result from the fact that there would be less competition and fewer small-diameter trees.

Dwarf-mistletoe occurs in both even-aged and uneven-aged stands. Because the proposed action would not cut any trees over 18 inches DBH, any infected trees over 18 inches would be left on site, where they would continue to infect understory trees until they die. Depending on site conditions, understory trees nearby may be removed as an isolation measure to reduce expansion of the infestation.

Most thinning and tree removal activities would use existing skid trails, but occasionally new ones would be required. Skid trails are designed to access the greatest amount of area while minimizing leave tree damage during removal.

Alternative 3 – Twelve-inch Diameter Limit

Alternative 3 is similar to the proposed action, except that the maximum size tree that would be cut is 11.9 inches DBH. The direct and indirect effects to even-aged stands and goshawk nesting areas in this alternative would be similar to Alternative 2 because the proposed action would cut very few trees in the 12- to 18-inch size-class in these areas.

The desired uneven-aged stand structures could not be achieved under this alternative because the amount of area in VSS 4 (12”–18” trees) would remain above the desired 20 percent. The current amount of VSS 4, 5, and 6 is 73 percent compared to the desired 60 percent. With no means for reducing the number of trees in the 12-to 17.9-inch size-class, there is a reduced ability to maintain groupings, create openings, and develop the desired VSS 1 and 2 size-classes. This alternative

would not result in the desired condition of a mosaic of uneven-aged groups of trees across time and space on the landscape.

Alternative 3 may result in more trees in the larger size classes in the short term, but they would not necessarily have the desired arrangement. Alternative 3 also would result in higher inter-tree competition, slower diameter growth, and a greater susceptibility to insect, disease, and fire. This would likely result in fewer large trees over the long run. Limiting tree cutting to trees below 12 inches would not allow for the creation of enough openings for seedling regeneration, canopy breaks, or a healthy understory. This alternative would retain a more continuous canopy and higher live fuel loading that is more likely to support a stand-replacing fire, which could kill the trees that this alternative was developed to retain (see Silviculture and Fuels Specialist Reports-PR 41 & PR 44).

Compared to the proposed action, thinning up to 12 inches would not allow for the removal of many of the dwarf-mistletoe-infected trees. These infected trees would continue to infect the understory and any new tree recruitment as long as they remained living. Dwarf-mistletoe treatment in this alternative would fail to meet the objective of developing healthy uneven-aged stands.

Comparison of Alternatives for Results

Table 20—Comparison of results and forecasts at 20 and 40 years for each alternative

Years	Alternative 2 PA – 18 inch	Alternative 3 Mod-PA – 12 inch
Trees per acre-2008	161	191
Basal area-2008	113	113
Average DBH-2008	7.5	7.5
Trees per acre-2028	140	171
Basal area-2028	91.5	102
Average DBH-2028	15.5	15.5
Trees per acre-2048	153	185
Basal area-2048	100.5	111
Average DBH-2048	17.0	17.0

Table 20 above predicts and compares the outcomes for both action alternatives. The figures provide estimates for the average trees per acre, basal area and diameter at breast height following mechanical treatments and prescribed burning as well as forecasting the same parameters at 20 and

40 year increments. It should be noted that the average tree diameter is similar in both alternatives; however the number of trees per acre as well as the basal area is less in Alternative 2. Therefore, the trees are growing faster under both action alternatives, but there will be less inter-tree competition in the Proposed Action.

Cumulative Effects

The cumulative effects time frame for this analysis is from 20 years ago to 20 years in the future. The area for this analysis is approximately a five-mile buffer around the project area, which includes most of the adjacent ecosystem management areas (EMA) in GA 13.

Table 21 and Figure 9 below display past projects affecting the cumulative effects analysis area from 1987 through the present. Past actions include 1,804 acres harvested with ground-based logging systems in the project area since 1987. Natural regeneration in these units is typically very dense, with almost 3 times as many trees as desired. The other management strategy was individual selection or small group selections that have resulted in uneven-aged stands with dense regeneration. These areas also have about 3 times the tree density as desired. This represents less than 7 percent of the cumulative effects analysis area.

Table 21—Past sales, treatments and acres in Jacob-Ryan since 1987

Past Sales	Treatment Type	Acres	Year(s)
Hidden Fire Salvage	Fire Salvage	49	1987
Jack Jolly	Group selection; Group shelterwood; Irregular shelterwood.	272	1992
Mistletoe	Shelterwood seed cut; Removal; Final removal; Intermediate.	936	1988/89
Wildfevre	Removal; Intermediate; Shelterwood seed cut.	547	1988/90
TOTAL	**ALL TYPES**	**1,804**	

Both the ADOT and Forest Service hazard tree removal projects were implemented for public safety, however the ADOT corridors are already experiencing heavy aspen regeneration and limited natural ponderosa pine regeneration. The Warm Fire Reforestation project planted approximately 450,000 seedling replacement trees over 1,600 acres of severely burned forest. Current survival rate is at about 90 percent after the first year. This provides a beneficial effect to burned landscape adjacent to the project area by reestablishing the appropriate forest cover. Concurrently, it provides a beneficial effect to the Jacob-Ryan area by limiting soil erosion and the transport of sediment into the project area.

The Warm Fire Recovery Project (EIS) proposes to remove burned trees by salvage followed by additional reforestation (plant 10, 000 acres in conifer seedlings). This project reduces future fuel loading, provides micro-site material for reforestation and public safety by removing potentially hazardous trees. The advantage to the Jacob-Ryan area is again to limit potential soil erosion and sediment transport.

Fracas is a wildlife habitat improvement project designed to restructure ponderosa pine on 2,000 acres adjacent to Jacob-Ryan into suitable northern goshawk habitat. The project involves both

mechanical thinning and prescribed burning moving the area towards a fire-adapted system southwest of Jacob-Ryan.

The Plateau Facility Fire Protection Project is the only project within Jacob-Ryan. It involves approximately 900 acres of sites with high value that are at risk from wildfire. They include sites such as Jacob Inn, two communication sites, Campground/picnic area, Forest Service administrative site and Visitors Center. The reason for separating the projects is because of the differing treatment strategy and existing conditions. These areas already have a hardened footprint because of the buildings, parking lots and other developed sites. Because of their continued use by the recreating public, these areas have not been subjected to vegetation treatments or natural fires allowing their surroundings to become a fire risk.

The Jacob-Ryan Project by the creation of the uneven-aged forest structure also is developing a fire-adapted landscape. It also helps protect the rural community around Jacob Lake. By moving the Jacob-Ryan area to a more fire-adapted ecosystem and reducing the high density of trees per acre to more historic conditions, there would be a reduced risk of a stand-replacing wildfire like happened at the nearby Warm Fire. Future plantings in the Warm Fire burn area may depend on seed crops from Jacob-Ryan and other ponderosa pine sites in the area. A beneficial effect of the improved site and vigor conditions in Jacob-Ryan is for larger, fire-resistant ponderosa pine trees needed as future seed sources for reforestation efforts.

The Warm Fire destroyed thousands of acres of mature and old trees. It is estimated that, with successful planting, it will take at least 200 years to attain the desired forest structure, and without planting it could take over 500 years. The importance of the Jacob-Ryan Project is to help protect against this type of occurrence.

Table 22—Current and future vegetation management activities in the analysis area

Activities	Treatment Type	Acres	Year(s)
ADOT Treatments	Hazard tree removal along the 89A and 67	300	2007
Warm Fire Hazard Tree	Removal of burned trees along FS roads	900	2008
Warm Fire Reforestation	Planting seedlings in Warm Fire burn area	1,600	2008
Warm Fire Recovery EIS	Salvage and replant high intensity burn areas	10,000	2009/11
Fracas Wildlife	Treat ponderosa pine for goshawk habitat	2,000	2008/09
Plateau Facility Fire Protection Project	Treat sites at risk from fire across the Kaibab Plateau (Jacob-Ryan area only)	900	2010
Jacob Ryan Veg, Mgmt	Stand restructuring using mechanical and prescribed burning treatments	26,000	2009/14

The proposed action combined with past, present, and future activities would contribute and only start moving toward the analysis area being at a lower risk to loss from a stand-replacing wildfire. The proposed action would protect existing large old trees and promote the development of future large trees, which are currently deficit in the geographic area as a result of the Warm Fire. It

would also protect existing seed sources and provide for maintenance of lower fuel conditions in the ponderosa pine stands, making them more resistant to disturbance. Ultimately, it would contribute to a shift toward the desired uneven-aged forest conditions identified in the Kaibab National Forest Plan.

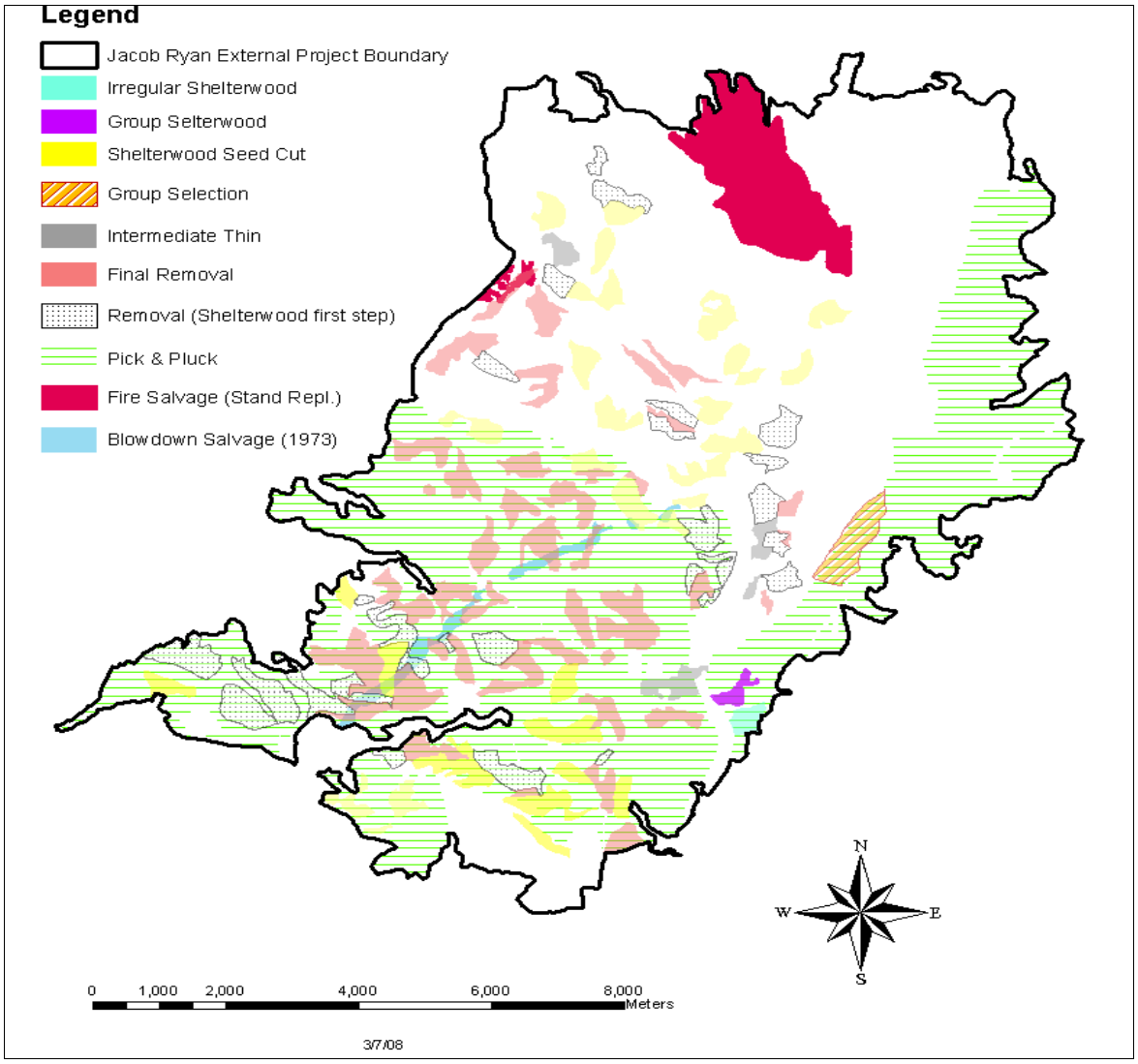

Figure 9—Vegetation management across the Jacob-Ryan project area since 1971

Fire and Fuels

Affected Environment

The fire and fuel conditions that currently exist within the Jacob-Ryan analysis area are a result of past management activities that include the following:

- The accumulation of forest fuels from aggressive fire suppression, limiting natural fire.
- Logging and other vegetation manipulation practices such as lop and scatter slash treatments that did not include follow-up prescribed burning.
- Over time, the dry-decaying material greatly increases the availability of receptive fuels, which in turn increases the number of potential ignitions and resistance to fire control.
- Livestock grazing (a minor consideration in the last 30 years), reducing the ability for natural fire to carry through surface fuels.
- Fire suppression strategies that have generally resulted in the forest becoming denser than 50 years ago, with many dispersed sapling and pole-sizes trees that can act as ladder fuel into the canopy.
- The combination of the above has altered the historic fire regime from a frequent fire return interval (low to moderate severity) to less frequent fires capable of moderate to high severity.

Fuel and Fire Behavior Modeling

Modeling of the existing vegetation was accomplished with the use of the Fire and Fuels Extension (FFE) imbedded within the Forest Vegetation Simulator (FVS) and analyzed in the silviculture report (PR 41). The FFE program calculates the potential fire intensity over time using current stand and fuel conditions to measure fire hazard. The Forest Service is using this program because it uses actual conditions instead of simulations. These models were compared with fire hazard models produced by Northern Arizona University and the Grand Canyon Trust and found to be in agreement. The FFE model can schedule or simulate fires at given points in time or when certain stand conditions are reached. Site specific modeling is used to create individual prescribed burn plans. Burn plans include silvicultural prescription elements along with fire behavior predictions and the weather parameters necessary to implement burning activities. The FFE simulator utilizes a combination of fire spread models that include the following:

- Rotheremels surface-fire spread equation. This equation provides the basis for the BEHAVE fire behavior modeling program for predicting surface fire attributes (Andrews 1986).
- Van Wagner (1977), Scott (2001) and Reinhardt's (2001) crown fire propagation model. This model defines the conditions that propagate crown fires by using weather parameters and tree canopy densities. This model also provides the basis for similar programs like NEXUS and Crown Fire Management Analysis.
- First Order Fire Effects Model (FOFEM, Reinhardt et al. 1997). This model simulates tree mortality, fuel consumption, and smoke production.

Current Fuel Loading

The ponderosa pine cover type is defined in Fire Behavior Fuel Model 9 (Anderson, H., 1982) and in National Fire Danger Rating System fuel model H and R. These fire prediction models use weather data to predict daily fire behavior. Fuel loads on the ground within the project area have been estimated to range from 3 to 20 tons per acre by Southwestern Region photo series modeling (USDA 1996). Fuel loading is not evenly distributed across the project area and varies depending on previous vegetation management, as shown below:

- Pre-1980s cutting units range from 5 to 10 tons per acre.
- Shelterwood and seed-tree cutting units range from 3 to 7 tons per acre.
- Old lop and scattered thinning units range from 10 to 15 tons per acre.
- Areas prescribe burned in the recent past (1990s) range from 5 to 10 tons per acre.
- Untreated areas range from 10 to 20 tons per acre.

According to the FFE model, the current canopy closure would likely result in a passive crown fire with pockets of active crown fire if ignited. Generally, prescribed burning would not occur when ground fuel loading exceeds 15 tons per acre. Fire burning with high fuel loads results in excessive temperatures and damage to soils and root structures. Field surveys of the project also documented many stands in fire regime condition classes 2 and 3. Fires in these stands are in a moderate to high risk for loss of key ecosystem components and a drastic change in vegetation composition and structure. Wildfire behavior, fire effects, and associated disturbances in these stands would be well outside the historical norm. Stands like the one below in Figure 10 provide ladder fuel from surface vegetation into the canopies of mature and old trees.

Figure 10—Stand fuel conditions where fire can readily move from the surface to tree tops

There have been approximately 250 wildfire occurrences across the District in the last 30 years (see Figure 11). The District averages 58 wildfires annually, many located within the Jacob-Ryan project area.

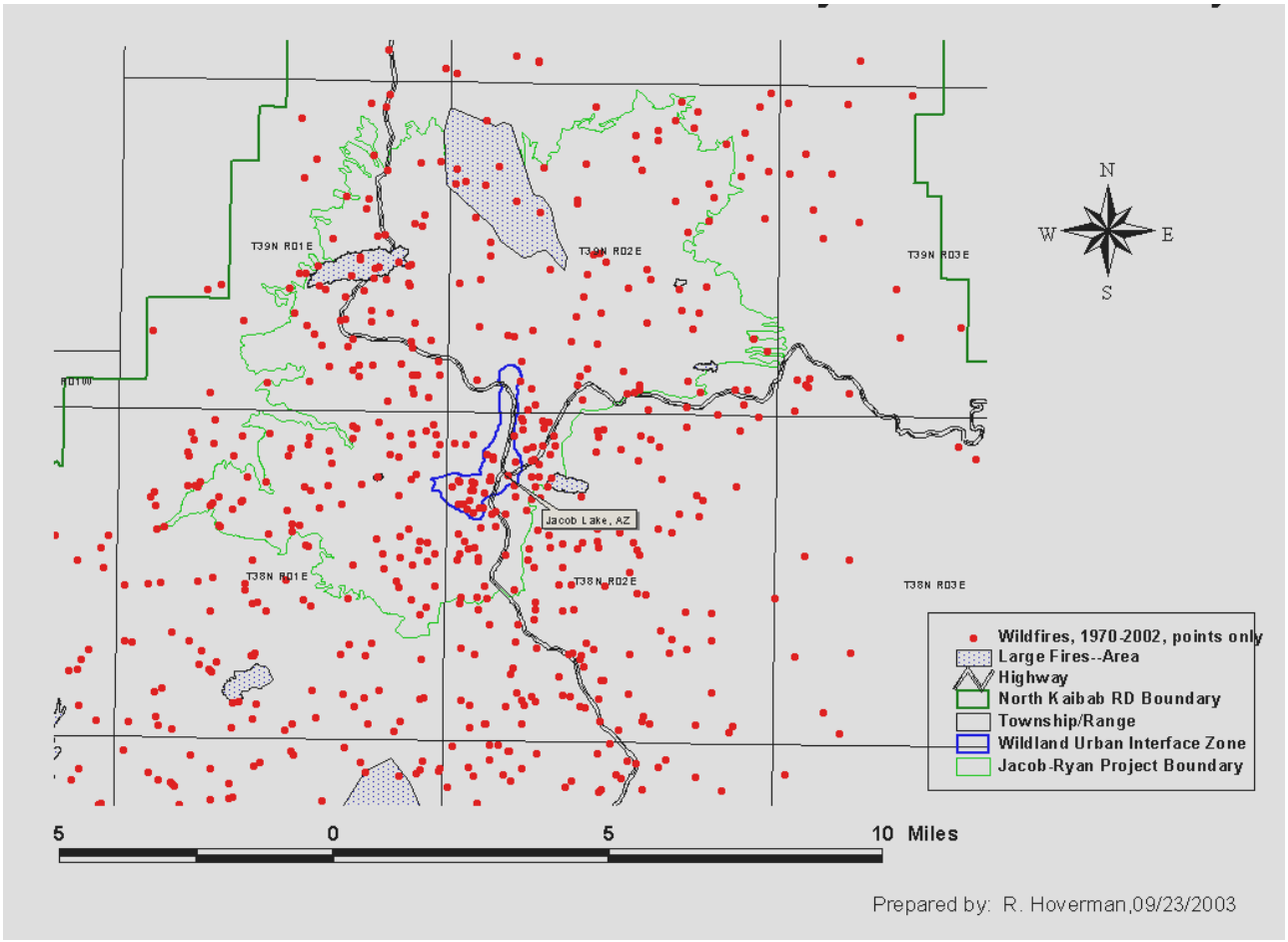

Figure 11—Wildfire occurrence on the North Kaibab Ranger District from 1970 to 2002

Direct and Indirect Effects from Prescribed Burning

Alternative 1

Under the No Action Alternative, no mechanical or prescribed burning treatments would occur. Surface and ladder fuels would continue to increase in amount and density, enhancing conditions that could result in a wildfire similar to the Warm Fire. Wildfires severely impair air quality by generating a great deal more smoke and tons of particulate many times greater than managed fires. Wildfires usually exceed National and State Air Quality Standards depending on the site and current fuel loads. However, they are natural phenomena not a planned ignition and even though they are monitored for safety concerns, they are exempt from meeting air quality standards. Wildfires also consume large areas of vegetation, degrade and destroy wildlife habitat, and damage soils, which can lead to erosion problems. This alternative does not provide the means to lessen the potential effects of a wildfire or reduce the risk of fire moving from the forest into the nearby wildland-urban interface.

Alternatives 2 and 3

The action alternatives are similar in that any prescribed burning would be conducted on the same acres. National and State air emission standards take into account weather conditions and fuel loads on the ground. Burn plan authorization by the Arizona DEQ specifies and limits the amount of acreage for burning so that the project burn would not exceed air quality standards. Forest Service fire personnel are in continuous contact with AZ DEQ during burn projects monitoring air quality. Tables 23 and 24 below display the average fuel loads, base canopy heights for trees and the expected fire-flame lengths of ground fires before and after treatments.

Even-aged stands and goshawk nesting areas would usually experience the same burning activities in both alternatives. Differences between alternatives would occur in the uneven-aged stands due to the size and number of trees removed. The number of trees removed would affect the amount of activity-created fuels left behind following mechanical treatments. Alternative 3 would create less activity fuels than Alternative 2. Both alternatives would require pile burning in some areas before safely initiating surface broadcast burning. Because areas exceeding 15 tons per acre would be hand piled and burned before surface or broadcast burning would occur, undesirable fire effects should be minimized. Implementation of Alternative 2 would involve the most ground disturbance and the most tree removal, thereby providing the most open areas to burn following mechanical treatment. These open areas would then be less in Alternative 3.

Table 23—Fuel conditions and fire behavior after Proposed Action treatments

	AVERAGE FUEL LOADS (tons per acre)	BASE CANOPY HEIGHT (feet)	FLAME LENGTH (feet)
Existing	3 - 20	8.36	11.71
Mechanical	10 - 20	16.18	7.48
Burning	5 - 7	25.66	7.81

Table 24—Fuel conditions and fire behavior variables after Alternative 3 treatments

	FUEL LOADS (tons per acre)	BASE CANOPY HEIGHT (feet)	FLAME LENGTH (feet)
Existing	3 - 20	8.36	11.71
Mechanical	7 - 20	15.68	7.80
Burning	5 - 7	24.65	7.73

Research has shown that prescribed burning alone (without thinning or manual fuel removal) can reduce surface fuel loads, stimulate nitrogen availability, and increase herbaceous productivity. This activity is possible depending on site suitability. However, igniting stands with heavy fuel loads increases the chance for higher leave-tree mortality and lethal soil temperatures (Covington and Sackett 1984, 1990, 1992; Harrington and Sackett 1990; Sackett et al. 1993).

Burn units would be developed utilizing existing roads, trails, and natural fire barriers. However, some hand fire lines might have to be constructed to safely control the burns. Even though these fire lines would be rehabilitated at project completion, some limited soil disturbance is to be expected in the short term. Other burn and soil protection design criteria (see Appendix H) would be followed in any of the action alternatives to minimize leave tree mortality, smoke particulate emissions, and soil damage.

Cumulative Effects from Prescribed Burning

Fuel loads due to the suppression of natural wildfires on the North Kaibab District extends the cumulative effects analysis area for fuels five miles outside the project boundary. It takes approximately 10 years in ponderosa pine stands to return to pre-burn fuel loads following a prescribed burn. Therefore, cumulative fuels effects are analyzed from 10 years before and 10 years after project implementation. The vegetation types surrounding the project boundary consists of pinyon/juniper/scrub oak on lower elevations and dense mixed conifer on the higher elevations. This first entry restoration prescribed burning and subsequent maintenance (not part of this analysis) prescribed burning within the project area would reduce wildfire intensity and reduce the potential of a wildfire leaving the analysis area. The overall Fire Regime Condition Class for the area is 2. The proposed vegetation management would improve the FRCC ranking for pockets of the area from 3 to 2 or from 2 to 1, but would not change the whole analysis area to a lower rating.

The 2006 Warm Fire burn area is directly adjacent to the project along the southern boundary. This fire initially met the criteria for wildland fire use and was consistent with the Kaibab National Forest Plan, Kaibab Fire Management Plan, and the Federal Wildland Fire Management Policy. The Warm Fire was managed for wildland fire use fire for approximately 2 ½ weeks and treated approximately 19,000 acres. High winds pushed the fire outside the management area, converting it to a wildfire suppression strategy and burning an additional 39,000 acres. The Warm Fire burned about 500 acres in the original Jacob-Ryan project area that has been removed from this analysis.

Relevant Effects from the Last 10 Years

The accumulation of activity fuels from past vegetation treatments and dead trees from past wildfires like the Willis and Hidden Fires within this analysis area have created substantial fuel loads along the boundary edges capable of feeding a wildfire. Prescribed burning within these old activity areas would enhance surface vegetation by reducing leftover dead and down slash, logs, and stumps. Areas that experienced large intense wildfires within the analysis area may be considered for additional treatment, but only after the effects of a second entry prescribed fire is evaluated.

Current and Foreseeable Actions

The Fracas Wildlife Project is scheduled to treat about 2,000 acres of ponderosa pine adjacent to the Jacob-Ryan project. It involves restructuring the stands to meet goshawk habitat guidelines and therefore a more fire-adapted landscape. There are two proposed actions that are adjacent to the Jacob Ryan project area. The Warm Fire Recovery Project is designed to remove standing dead fuel followed by replanting of seedling trees to help initiate and speed recovery of the burn area.

The Plateau Facility Fire Protection Project is a logical extension for the Jacob-Ryan proposed action. It is designed to protect government facilities, private inholdings and other sites of value from wildfire. There could be some short-term localized increases in fuel loading from thinning, but cumulatively fire severity would be decreased. All three projects would each contribute to a much lower risk of stand-replacing wildfires for the analysis area. Wildfires may still occur, however they would likely be low-intensity ground fires resembling those that occurred historically.

Conclusion

The net effect of the proposed action when combined with the ongoing and planned actions would be a decrease in stand densities, a decrease in down woody fuels and flame lengths, and an increase in crown base height. Potential fire risk would decrease over time within the analysis area. Changing the vegetation structure in the project area stands also changes some active-crown fire acreages to potential passive-crown fire acreages. More areas would then be capable of supporting frequent, cooler surface fires. The Jacob-Ryan Project contributes to achieving a fire-adapted landscape on the District.

Air Quality

Affected Environment

Congress passed the Clean Air Act in 1970 with amendments in 1977 and 1990. The purpose of the act is to protect and enhance air quality while ensuring the protection of public health and welfare. The act establishes national air quality standards that must be met by state and federal agencies, including the Forest Service. States are given the primary responsibility for air quality management. The Clean Air Act requires states to develop implementation plans that identify how the state will attain and maintain air quality standards. The State of Arizona Department of Environmental Quality (ADEQ) is the responsible agency within Arizona. The Clean Air Act requires that federal agencies do not contribute adverse impacts to Class 1 air-sheds. Local Class 1 air-sheds include the Grand Canyon, Bryce Canyon, and Zion National Parks. The Kaibab Plateau, including the planning area, is designated a Class II air-shed and the air quality normally is good to excellent.

Air quality within the planning area is primarily affected by conditions and situations outside the area such as coal-burning power plants, industrial facilities, and vehicle emissions from large metropolitan areas west and southwest of the area. Emissions from these sources cause periodic air quality problems, especially during periods of regional high air-pressure weather patterns or heavy winds from the south and southwest which add dust to the atmosphere. Temporary air quality problems can also occur when wildland fires occur in the planning area or region. Forest Service fire personnel are in routine contact with AZ DEQ during wildfires and as plan requirements during prescribed burns, monitoring air quality from smoke ensuring compliance with air quality standards.

There is no air quality monitoring station on the Kaibab Plateau. The Grand Canyon National Park monitors air quality at Indian Gardens on the South Rim and for visibility from the South Rim to the canyon floor. There is also an air quality monitoring station near Page, Arizona. Its primary purpose is to measure particulate production from the Navajo power generating plant. There are no areas in northern Arizona on the ADEQ air quality watch list and no areas in northern Arizona or southeastern Utah on the Environmental Protection Agency's non-attainment list for particulates or emissions. A general climate summary for precipitation and temperatures are provided in Appendix C.

Direct and Indirect Effects by Alternative

Alternative 1 – No Action

Under the no-action alternative, there would be no burning of slash piles or prescribed burning of the project area, and therefore there would be no changes to the current fuel load profile. The risk to air quality is greater under the no-action alternative because it would not reduce the potential for

a stand-replacing wildfire that would generate large amounts of smoke that could impair air quality (in tons of particulates produced) and impose a general health risk. High-intensity stand-replacing wildfires produce emissions that are several orders of magnitude greater than those occurring from low-intensity ground fires.

Using the SASEM program (Simple Approach Smoke Estimation Model, version 4.1), simulations were run to determine if the proposed action and other alternatives would exceed the standards for particulate matter (PM-2.5 µm and PM-10 µm). The Clean Air Act establishes National Ambient Air Quality Standard to protect public health of sensitive populations such as asthmatics, children and the elderly. The standard emissions are shown below in Table 25.

Table 25—National Ambient Air Quality Emission Standards to protect public health

Emission Type	Standard Emission Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg / m^3	8 hour period
Particulate Matter PM_{10}	150 µg / m^3	24 hour period
Particulate Matter $PM_{2.5}$	35 µg / m^3	24 hour period

Alternative 2 – Proposed Action

The Arizona Department of Environmental Quality (ADEQ) has to approve burn plans 24 hours before implementation. They have the delegated responsibility to regulate planned emissions and can reduce the number of acres or cancel the burns all together if there are unfavorable weather conditions.

An important consideration of smoke effects on the Kaibab Plateau is that there are no communities or health organizations (hospitals/nursing homes) in the vicinity where air quality is of immediate concern. Individuals participating in recreation activities on the Plateau could be affected, but they would also be forewarned through the media, signage, and visitor centers. Actual direct or indirect effects on individuals are expected to be minimal.

Alternative 3 – Twelve-Inch Diameter Limit

Smoke effects under Alternative 3 would be very similar to the proposed action because all planned emissions are regulated by Arizona DEQ. Because there would be less activity slash, there would likely be less smoke produce during planned burning activities. In the case of a wildland fire after treatment, this alternative would likely produce more emissions than the proposed action.

The tables below provide average estimated emissions depending on available fuel loads for a wildfire without fuel load reductions, prescribed burning for the action alternatives and estimated emissions that would result from a wildfire burning in the project area 10 years after the same area is prescribe burned..

Table 26—Estimated air quality emissions during a wildfire without fuel load reductions

Emission Type	Quantities (tons/acre)
Particulate Matter PM-2.5	0.32
Particulate Matter PM-10	0.35
Carbon Monoxide	2.68
Carbon Dioxide	64.14
Methane (CH4)	0.11
Non-methane Hydrocarbons (NMHC)	0.10

Table 27—Air quality emissions produced by prescribed landscape burning

Emission Type	Quantities (tons/acre)
Particulate Matter PM-2.5	0.26
Particulate Matter PM-10	0.29
Carbon Monoxide	2.22
Carbon Dioxide	47.71
Methane (CH4)	0.10
Non-methane Hydrocarbons (NMHC)	0.08

Table 28—Air quality emissions by a wildfire after the same lands were prescribe burned

Emission Type	Quantities (tons/acre)
Particulate Matter PM-2.5	0.14
Particulate Matter PM-10	0.15
Carbon Monoxide	1.17
Carbon Dioxide	27.17
Methane (CH4)	0.05
Non-methane Hydrocarbons (NMHC)	0.04

Cumulative Effects

Because smoke dissipates in a relatively short timeframe, and the timing and acres of burns are regulated by Arizona DEQ, the cumulative effect of the Proposed Action would not additively exceed air quality standards.

Soils and Watershed

Affected Environment

Terrestrial Ecosystem Survey map units displayed in Table 29 for the proposed Jacob Ryan project area are assigned a soil condition category (satisfactory, impaired, or unsatisfactory) which indicates the current status of soil functions. The three soil functions evaluated are stability, nutrient cycling, and the hydrologic function. Figure 12 displays the ecological map unit location within the project area. Soil condition categories reflect soil disturbances resulting from both planned and unplanned events. Map units 293 and 620 located within selected cutting units are identified as being impaired. This is due to a lack of downed coarse woody debris. Map unit 9 is identified as being in unsatisfactory soil condition due to soil compaction. All map units are assigned best management practices (BMPs) designed to maintain or improve soil condition. The purpose and objective of determining soil condition is to assess existing soil (site) productivity.

Soil condition assessments are considered a form of soil monitoring as required by Forest Land Management Plans including "significantly changes in productivity of the land" [36 CFR 219.12 (k) (2)]. Regulations state "that all management prescriptions shall conserve soil and water resources and not allow significant or permanent impairment of the productivity of the land" [36 CFR 219.29 (a) (1)], (USDA Forest Service 1991). The National Forest Management Act of 1976 stresses the maintenance of productivity and the need to protect and improve the quality of soil and water resources, and to avoid permanent impairment of the productive capability of the land (FSM 2500, 1990). Forest Service policy states that management practices must be designed and implemented to maintain or improve the long-term inherent productivity capacity of the soil resource (FSH 2509.18, 1991).

Soil field data was collected in the project area in August, 2007 to determine the status of existing soil conditions. Protocols outlined in the R3 Supplement 2509.18-99-1 were followed for collecting soil condition data. Eighty-nine 1/10th acre plots were randomly selected in 16 ecological map units within two 4^{th} level (HUC) watersheds. The surface soil layer (A horizon) varies in thickness and is generally distributed evenly across the soil surface. This horizon is where plant and animal organic matter accumulates, begins to decompose and eventually is incorporated into the soil. Indicators of soil function were evaluated based on the data collected and each map unit was assigned a soil condition category.

Table 29—Acres of soil condition category by ecological map unit and watershed

Kanab Creek Watershed (15010003)			Marble Canyon (15010001)	
Map Unit Symbol	**Soil Condition Category**	**Map Unit Acreages**	**Soil Condition Category**	**Map Unit Acreages**
9	Unsatisfactory	356	----	----
252	Impaired	94	----	----
263	Satisfactory	1	----	----
264	Unsatisfactory	141	----	----
271	Satisfactory	255	Satisfactory	6
272	Impaired	15	----	----
273	Impaired	19	----	----
293	Satisfactory	11,165	Impaired	749
294	Satisfactory	11,126	Satisfactory	738
297	Satisfactory	734	Satisfactory	70
298	Satisfactory	757	Satisfactory	29
299	Satisfactory	295	----	----
620	Impaired	484	----	----
621	Satisfactory	435	----	----
624	Impaired	33	----	----
625	Satisfactory	1	Satisfactory	3
Total Acres		**25,911**	**Total Acres**	**1,595**

Vegetative Ground Cover

Vegetative ground cover consists of dead plant material (litter) and live vegetation in contact with the surface soil. Ground cover is an important factor in management of on-site soil loss and is one indicator considered in the evaluation of soil condition. Ground cover is expressed as a percentage of the area covered by the total of litter and basal area of vegetation. Tolerable vegetative ground cover is associated with soil loss and is the minimum amount of cover needed to sustain soil productivity. Natural vegetative ground cover is associated with climax vegetation conditions. Both tolerable and natural vegetative ground cover values presented in the table below for each ecological map unit were obtained from Terrestrial Ecosystem Survey of the Kaibab National Forest. It is important to note that vegetative ground cover may vary widely within an ecological map unit. Figure 12 displays the ecological map unit location within the project area. The values presented for current vegetative ground cover are based on an evaluation of multiple plot data collected in each ecological map unit (except for ecological map units 263 and 625) within the project area.

Table 30—Vegetative ground cover values for each ecological map unit by watershed

Map Unit Symbol	Kanab Creek Watershed (15010003) Vegetative Ground Cover (%)			Marble Canyon (15010001) Vegetative Ground Cover (%)		
	Tolerable	Current	Natural	Tolerable	Current	Natural
9	10	20	90	---	---	---
252	45	15	50	---	---	---
263	05	15	30	---	---	---
264	45	20	55	---	---	---
271	70	81	75	70	85	75
272	10	40	65	---	---	---
273	30	25	60	---	---	---
293	05	95	85	05	95	85
294	50	85	85	50	95	85
297	05	80	80	05	62	80
298	50	75	80	50	65	80
299	65	70	70	---	---	---
620	50	35	60	---	---	---
621	50	80	50	---	---	---
624	65	100	85	---	---	---
625	75	85	85	---	---	---

** Values are rounded to the nearest 5%.

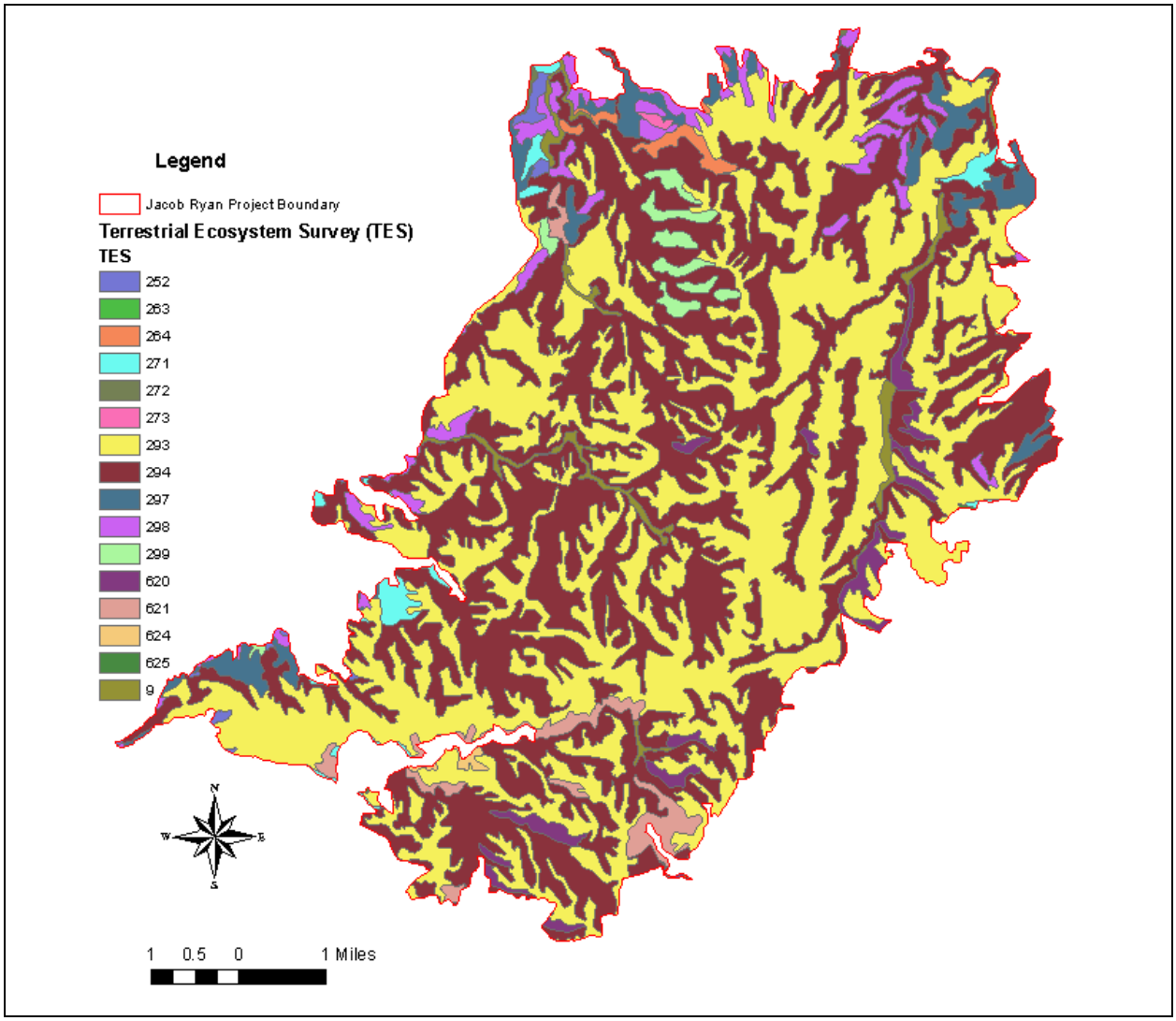

Figure 12—Location of ecological map units within the Jacob-Ryan project area

Soil Condition Category by 4th Code (HUC) Watershed

Acres of soil condition category are summarized for each 4th level watershed. The size of the Kanab Creek Watershed is 1,094,129 acres and the Marble Canyon Watershed is 939,067 acres. The status of soil condition in the two watersheds is displayed in Table 31 by the number of affected project acres and by the percentage of acres compared to the total watershed. Figure 13 below also gives a visual perspective for the amount of project involvement within the two watersheds.

Table 31—Current soil condition and percent by watershed

	Kanab Creek Watershed		Marble Canyon Watershed	
Soil Condition Category	**Acres**	**%**	**Acres**	**%**
Satisfactory	24,769	2.30	846	0.09
Impaired	645	0.06	749	0.08
Unsatisfactory	497	0.05	0	0.00
Total Acres	**25,911**	**2.41**	**1,595**	**0.17**

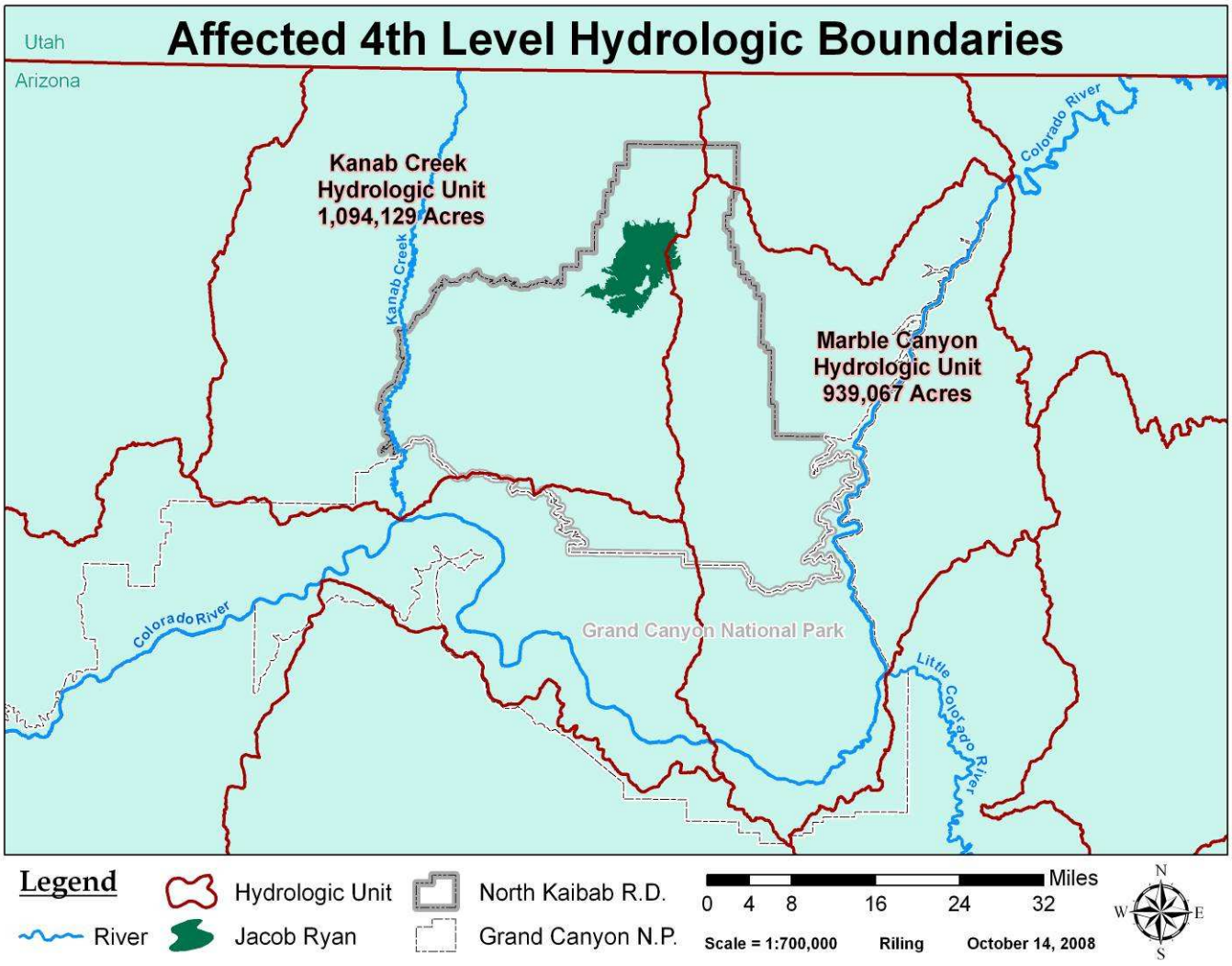

Figure 13—Affected watersheds in relation to project area and surface water courses

Surface Water Quality Assessment

Surface water from the project area potentially flows into the Marble Canyon and Kanab Creek portions of the Colorado River. However, stream courses are primarily ephemeral and stream flows generally occur only after large, high intensity rainstorm events or from runoff from spring snow melt. The sporadic nature of these stream flows may result in sediment being potentially stored within these ephemeral stream channels and then transported during surface runoff events. Streams courses are buffered from management activities so they may continue to act as sediment filters during precipitation or snow melts events. Kanab Creek and the Marble Canyon portion of the Colorado River are not identified on Arizona's 2006 draft list of 303(d) for Impaired Waters. The perennial stream in Marble Canyon is about 30 miles from the project area. The perennial stream in Kanab Creek is about 23 miles from the project area. Figure 13 shows the relationship of the project area, surface water courses and the affected watersheds.

Erosion Hazard

USDA Forest Service, Region 3 defines erosion hazard as the probability of soil loss resulting from complete removal of vegetation and litter (USDA Forest Service 1986). A soil erosion hazard class (slight, moderate, or severe) is assigned to each ecological type (Brewer et. al. 1991). Table 20 displays the number of acres of each erosion hazard class by each watershed.

Table 32—Acres of erosion class by watershed

Watershed (4th Code)	Erosion Hazard Class (Acres)		
	Slight	Moderate	Severe
Kanab Creek (15010003)	12, 270	12, 528	1,113
Marble Canyon (15010001)	819	767	9

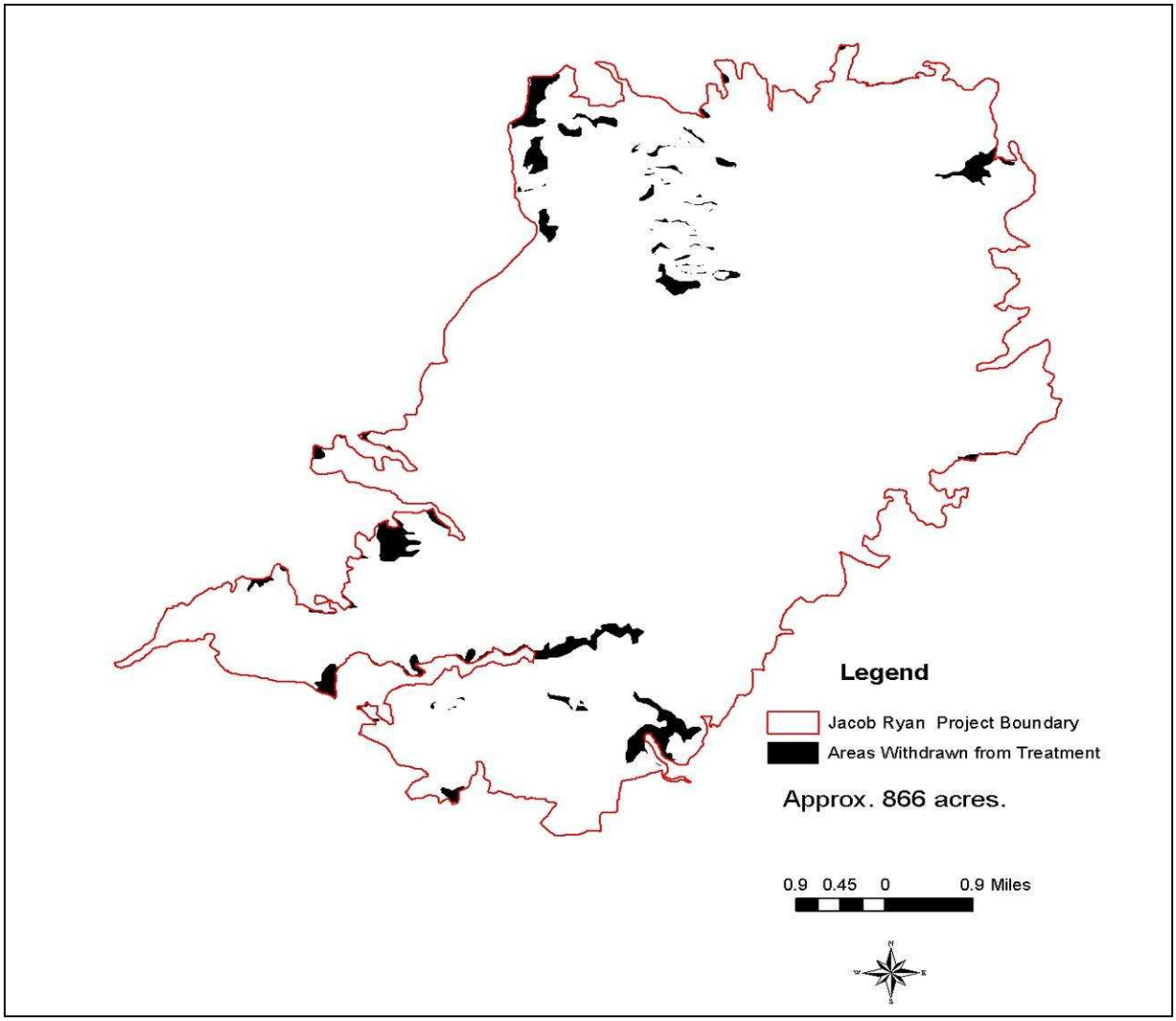

Figure 14—Ecological units of steep slopes and pinyon-juniper ecosystems that contain unsatisfactory and impaired soils withdrawn from treatment within the project area

Figure 14 displays the project areas of concern that are being withdrawn from thinning treatments either because they either occurred in pinion/juniper vegetation or were on a slope not suitable for treatment. The withdrawal is approximately 860 acres and is in portions of seven different ecological types in map units 252, 264, 271, 272, 299, 621, and 625. The majority of these acres are project boundary fringe areas in uneven-aged PFA non-nest areas (340 acres) and uneven-aged foraging areas (379 acres). The remaining acres are scattered as incidental patches, mostly smaller than 30 acres in size. These areas will not be treated for this project.

Direct and Indirect Effects by Alternative

Alternative 1 – No Action

Under the no-action alternative, no mechanical thinning or prescribed burning would occur. The project area would not become more fire-adapted and there would be a continued risk for high-intensity stand-replacing fire. The heat and organic consumption of a high-intensity wildfire could severely impact soil stability, nutrient cycling, and hydrologic functioning, which make the soil incapable of absorbing water during precipitation events. High intensity wildfires remove ground cover vegetation and decomposed organic matter, and create water repellent soils. Ash and erodible soils could enter ephemeral stream channels during rainfall runoff, further increasing channel scour, incision, and debris flows, and could degrade water quality.

Alternative 2 – Proposed Action

The prescribed thinning and vegetation treatments of the proposed action would contribute to an increase in the amount and diversity of grasses and forbs, provide areas for nutrient cycling and moisture uptake, and protect soils from accelerated erosion. However, thinning activities can cause soil disturbance; the amount of disturbance varies depending on the timing and intensity of treatments and the equipment used.

Mechanized equipment would be used in the uneven-aged stands for the proposed action. Activities include whole tree skidding, decking, road maintenance, and machine and hand piling of slash. Each of these activities could temporarily result in some degree of soil displacement, compaction, on-site soil loss, and disturbance to ground cover within the treatment units. Skid trails and landings would experience some degree of ground cover loss and an increase in bare soils. The application of best management practices (BMPs) that reduce potential impacts from management activities (including limiting operation on sensitive soils when wet) would reduce on-site soil loss, runoff, and sedimentation so that there should be no adverse long term effects to soils from timber operations.

Soil Bearing Strength (Wet Soil Operability): Map unit 9 occurs on nearly level to gently sloping linear and concave valley plains; soils within this map unit lose soil bearing strength when the soil surface and subsurface layers become wet during times of spring snow melt and intense summer rain storms. The reduction of soil bearing strength when wet allows these acres to become highly susceptible to compaction, rutting, displacement, and gully formation (Brewer et. al., 1991). Treatments in this map unit have specific design criteria that entail the use of existing roads, directional tree falling, and end-lining felled trees to minimize soil impacts. The sensitivity of soils in this map unit would preclude creating log landings or doing any machine piling of activity-created slash.

Map units 293, 294, 297, 298, 620, and 624 have soils containing montmorillonite, a clay mineral common for the soils within the project area that is responsible for the soils having a low bearing strength when wet (Brewer et. al., 1991). Unsurfaced roads, skid trails, landings, and areas subjected to machine piling are highly susceptible to rutting, compaction, and soil displacement during wet soil conditions. The application of best management practices (BMPs) that limit equipment operations on sensitive soils when wet would reduce the potential for rutting, compaction, and soil displacement, therefore preventing adverse, long-term effects on soils.

A recent study conducted in Northern Arizona documented the effects of different harvest systems and associated severity levels on soil compaction. The study showed that timber management operations conducted under dry soil conditions produced no significant differences in soil compaction between undisturbed (control) areas and those with harvest severity or differing harvest systems. However, intermediate and high soil profile disturbance was greater under a

whole tree harvest system than in machine or hand harvest systems. Soil profile disturbance was defined as disturbance or removal of the organic soil or O-horizons (Korb et al. 2007).

Soil Erosion: Kinetic energy expended by falling rain is primarily absorbed by vegetation and litter and is the greatest deterrent in preventing surface sheet and rill erosion (Poff, 1996). All mechanized timber activities remove vegetative ground cover, exposing bare soil in varying degrees and influencing runoff and erosion (Cram 2007). Current soil conditions within the project area indicate sheet and rill erosion is expected to be minimal. Steep slopes with exposed mineral soil further increase the potential for runoff and sedimentation. However, light to moderate disturbances in which vegetative ground cover is only disturbed but not displaced did not increase soil erosion and runoff over undisturbed control areas, even on steep slopes. Steep slopes greater than 30 percent are potentially more susceptible to severe disturbance resulting in exposed bare soil following thinning operations (Cram et al., 2007).

Silvicultural treatments that minimize disturbance to the forest floor and do not remove large amounts of the forest canopy experience little soil loss to erosion and displacement (Poff 1996). Soils rated as having a moderate or severe erosion hazard have the greatest potential for soil loss when ground cover is removed. Implementation of Best Management Practices (see Appendix H) would maintain or improve vegetative ground cover and reduce soil loss, therefore preventing long term adverse effects on soils.

Roads: Roads associated with vegetation management historically are a source of sediment production and transportation affecting streams and water quality. There are no new roads or temporary roads associated with this project. All management activities would use existing open roads or previously closed administrative roads to access project area stands. Therefore, on-site soil loss and sediment production is expected to be very minimal. Any "closed" road opened and used for the project would be closed following project completion.

Areas susceptible to head-cuts and gullies occur in ephemeral stream channels, meadows and narrow alluvial plains with deep soils. Project activities would not occur in these sensitive areas. Existing head-cuts and gullies are currently in a state of recovery from past management activities and should continue toward a state of stability and recovery.

Thinning in goshawk nesting areas and even-aged stands: Most thinning activities in these areas would be conducted using hand tools. Use of mechanized equipment in these areas would be minimal. Disturbance to the vegetative ground cover would be light, with minimal displacement of surface litter. No increases in on-site soil loss and runoff are expected to occur. The effects to soils condition in these areas is expected to be light and short term.

Fuel Treatment: Slash from thinning activities may be machine piled and burned at the log landing site. Potential adverse effects from pile burning may be a reduction in soil productivity by the removal of organic matter and nutrients from the site. The advantage of this treatment is the removal of potentially dangerous heavy fuels before surface burning occurs. In addition, machine piling and burning would occur on log landing sites without impacting soils in the main silvicultural areas. Slash generated from thinning small diameter trees would be hand piled and then burned when conditions are suitable. Although hand piles occupy small areas, there could be many of these piles, depending on the amount of slash generated.

Burning slash piles results in a high-intensity fire, generating hot soil temperatures. Surface soil temperatures can reach 700°C and 250°C below the surface. Heated soils experience changes in pH, soil nitrogen, and organic carbon. Soil fungus densities are reduced under the slash piles by the high-intensity fire. Slash pile scars recover slowly and may remain void of vegetation for long periods of time.

The planned broadcast burns are low-intensity fires that release nitrogen and other nutrients to the soil, benefiting herbaceous vegetation (Lowe 2005). Usually broadcast burns do not entirely consume forest duff and can reduce fuels without removing effective ground cover (Poff 1996). Prescribed burns would use existing roads and natural fuels breaks to the extent possible.

Because the existing road density in the area is very high, roads would provide adequate fire lines in a majority of the area. In some cases, fire lines would be constructed to complete a burn perimeter by connecting roads. This would result in a temporary disturbance and soil exposure. Because these areas would be limited and Best Management Practices would be used in implementation, there would be minimal effects to soils.

Alternative 3 – Twelve-Inch Diameter Limit

Effects of implementing Alternative 3 would be very similar to the proposed action, especially in the even-aged and goshawk nest areas. Thinning would occur on the same acres of land, but there would be fewer disturbances to soils because activity levels would be reduced because fewer trees would be cut. Increases in understory vegetative cover following treatments would be expected, but to a lesser degree than the proposed action.

Cumulative Effects

The cumulative effects analysis area includes the Kanab Creek (15010003) and Marble Canyon (15010001) watersheds. The time frame is from 20 years ago to 20 years in the future. The project area is about 26,000 acres or 1.3 percent of the nearly 2 million acres of the combined watershed areas. At the broadest scale, the project is limited in scope and intensity with minimal short duration effects to project area soils.

Watersheds affected by livestock grazing in the project area have generally improved over the past several decades. Improved vegetative ground cover is the result of changes in grazing rotation strategy, season of use, and stocking levels. Current soil and vegetation conditions are approaching or have achieved a proper functioning status across most of the project area.

There have not been any large-scale vegetation management projects in the analysis area since about 1987. Most vegetation management projects since 1987 were small, addressing human-caused disturbances, natural events such as salvage following wildfires or blowdowns, and habitat improvement projects (see Appendix E). These activities did not usually exceed 1,000 acres across the analysis area and had minimal effect on the overall soils condition. Table 33 displays the affected acres by watershed for the type of treatment activity proposed in the project area. The majority of the vegetation treatment is occurring in the Kanab Creek Watershed. Map units previously classified as impaired or unsatisfactory because of compaction or lack of course woody debris would receive minimal motorized access and most activity created debris would be lop and scattered to benefit soil nutrient cycling.

Table 33—Displays the affected acres by watershed for the Jacob-Ryan Project

TES Map Units	Kanab Creek Watershed 4th level HUC-15010003			Marble Canyon Watershed 4th level HUC-15010001		
	Commercial thin	Pre-commercial thin	Broadcast burn	Commercial thin	Pre-commercial thin	Broadcast burn
	Acres	Acres	Acres	Acres	Acres	Acres
9	228	73	0	0	0	0
252	0	0	0	0	0	0
263	0	0	0	0	0	0
264	0	0	0	0	0	0
271	0	0	0	0	0	0
272	0	0	0	0	0	0
273	0	0	0	0	0	0
293	9,123	1,353	10,476	648	101	749
294	9,195	1,303	10,498	635	103	738
297	582	45	627	64	5	69
298	551	79	630	29	0	29
299	0	0	0	0	0	0
620	400	32	432	0	0	0
621	0	0	0	0	0	0
624	32	0	32	0	0	0
625	0	0	0	0	0	0
Totals	**20,111**	**2,885**	**22,695**	**1,376**	**209**	**1,585**

A greater amount of ground disturbance is expected in Alternative 2 because more trees are removed; however the affected acres for both action alternatives are the same. Mitigation measures and best management practices are utilized to minimize ground cover disturbance, erosion and sediment movement. Effects from vegetation management are expected to be minimal and short in duration not cumulatively affecting the soil condition of the project area. Coarse woody debris will be lopped and scattered in map units 9, 293 and 620 with the objective of improving soil condition.

Recreational activities continue to have localized effects, including soil disturbance and compaction. These effects are primarily concentrated next to roads and in meadows. Off-road vehicles, the repeated use of accessible campsites, and fuel wood gathering will be addressed in the upcoming travel management planning process.

The effects of the fire-use and subsequent wildfire suppression activities from the Warm Fire varied across the cumulative effects analysis area. Effects to soils were severe in some areas and low in others. About 500 acres of the original Jacob-Ryan Project was consumed in the Warm Fire and subsequently removed from the project. The burn affected the southeast portion of the project area. Table 34 summarizes acreages that burned under fire use conditions, along with the approximate acres to be burned in the Jacob-Ryan Project. Considering the state of recovery of the Warm Fire and the amount of low-intensity prescribed burning to take place in Jacob-Ryan, the net effect on soils and watersheds should be minimal, especially a year following the proposed prescribed burn.

Table 34—Acres burned as a result of fire use and prescribed burns

Wildfire Use Area	Year	Kanab Creek 15010003			Marble Canyon 15010001
		White Sage 15010003-02	Snake Gulch 15010003-07	Lower Johnson 15010003-04	House Rock 15010001-01
Warm Fire	2006	6,809	6,514	----	12,130
Jacob-Ryan Project		8,000	8,000	8,000	

Table 35—Acres burned as a result of wildfires

Wildfire Name	Year	Kanab Creek 15010003			Marble Canyon 15010001
		White Sage 15010003-02	Snake Gulch 15010003-07	Lower Johnson 15010003-04	House Rock 15010001-01
Big Wildfire	2002	----	----	----	25
Apron Wildfire	2002	----	----	9	----
Plateau Wildfire	2002	----	----	6	----
Warm Wildfire Suppression	2006	18	16,178	----	16,907

Although past, present, and foreseeable land management activities, particularly fire suppression, historical livestock grazing, roads, timber harvesting activities, and recreation use had and will continue to have an impact on soil and water resources of the watersheds, most soils are in satisfactory condition. Current grazing, timber management, and recreational activities implement Best Management Practices to maintain proper amounts of vegetation and suitable soil function.

The prescribed thinning and vegetation treatments proposed by the action alternatives would contribute to an increase in the amount and diversity of grasses and forbs, provide areas for nutrient cycling and moisture uptake, and protect soils from accelerated erosion. The cumulative effect of the proposed action when added to the past, present, and foreseeable actions is improved overall soil and watershed trends and reduced potential for a high-intensity wildfire event.

Summary

Given the existing condition of the projects soil and water resources, there is a low-degree of expected impacts or appreciable cumulative effects on the status of water quality and soil condition within the affected watersheds by using and monitoring of best management practices.

Wildlife

Affected Environment: Federally Listed Species

Animal species listed under the Endangered Species Act identified by the U.S. Fish and Wildlife Service (http://www.fws.gov/arizonaes/) for Coconino County is shown in Table 36 below.

Table 36—Federally listed threatened and endangered species in Coconino County, AZ

Common Name	Status	Arizona Range and Habitat	Habitat in Area
Kanab amber snail	Endangered	Few small, isolated populations: in Utah and in Grand Canyon National Park. Travertine seeps and springs.	N
Humpback chub	Endangered	Colorado and Little Colorado Rivers. Critical habitat in Grand Canyon.	N
Razorback sucker	Endangered	Critical habitat includes portions of Colorado, Salt, and Verde Rivers.	N
California brown pelican	Endangered	No breeding records in AZ. Uncommon transient on lakes and rivers.	N
California condor	Endangered	Reintroduction of birds (classified as experimental nonessential population) to northern AZ began in 1996. Vermillion Cliffs, Kaibab Plateau, and Grand Canyon.	Y
Southwestern willow flycatcher	Endangered	Cottonwood/willow and tamarisk vegetation communities along rivers and streams.	N
Common Name	**Status**	**Arizona Range and Habitat**	**Habitat in Area**
Black-footed ferret	Endangered	Experimental nonessential population reintroduced into Aubrey Valley in western Coconino County in 1996. Grasslands with large prairie dog colonies.	N
Apache trout	Threatened	Native to White Mtns., introduced population in North Canyon Creek on North Kaibab District. Cold mountain streams with low-gradient meadow reaches.	N
Little Colorado Spine-dace	Threatened	Critical habitat in East Clear Creek, Chevelon Creek, and Nutrioso Creek.	N
Chiricahua leopard frog	Threatened	Montane central AZ east and south along Mogollon Rim and southeast AZ. Requires permanent or near permanent streams, rivers, ponds, or stock tanks free from introduced fish, crayfish, and bullfrogs.	N
Mexican spotted owl	Threatened	Patchily distributed in canyons and dense, multi-age forests at 4,100-9,000 feet. Critical habitat designated in mixed conifer and pine-oak forests on portions of Kaibab NF.	N
Yellow-billed cuckoo	Candidate	Large blocks of riparian woodlands (cottonwood, willow, or tamarisk).	N

The humpback chub, Little Colorado spine-dace, razorback sucker, southwestern willow flycatcher, brown pelican, yellow-billed cuckoo, Kanab amber snail and Chiricahua leopard frog are removed from further analysis because historic and occupied habitats for these species are located outside the North Kaibab Ranger District. Black-footed ferrets were re-introduced into western Coconino County in 1996; however, they do not occur on the Kaibab National Forest.

Apache Trout

Apache trout occur in North Canyon Creek on the Forest approximately 20 miles southeast of the project area. The Arizona Game and Fish Department introduced this population in 1963 from

Ord Creek in eastern Arizona. The population is outside its native habitat, but is maintained as a recovery species due to its genetic purity.

Mexican Spotted Owl

Mexican spotted owl is known to breed along the cliffs below the north rim of the Grand Canyon, but resident birds do not occur on the District. Nevertheless, critical habitat (CH) has been designated for this species in the central and southern portions of the District. The Jacob-Ryan project area is not within or in the vicinity of designated critical habitat.

California Condor

The California condor, a federally listed endangered species, was declared suitable for reintroduction efforts in the Southwest as a non-essential experimental population in Arizona (USFWS 2002). The California condor reintroductions in Arizona started in 1996, with releases on the Vermillion Cliffs above House Rock Valley on the eastern border of the District. Later, additional releases took place in House Rock Valley and at the Hurricane Cliffs to the west of the District.

The California condor is a large-ranging species traveling up to a hundred miles to forage. Condors roost and nest in steep terrain with rock outcroppings, cliffs or caves. District use by the condor is now year-round for both breeding and nesting. However, no eggs have been hatched on the District through the 2008 nesting season. The number of condors present varies with the time of year and food availability. Condors may use the project area to forage or rest, but it is unlikely for them to nest or roost in the area (Chris Parrish, personal communication – PR 62, Peregrine Fund). Condor Conservation Measures designed to help alleviate human interference would be implemented during all phases of the project (see Appendix H).

Direct and Indirect Effects to Threatened and Endangered Species

Informal consultation was initiated with the US Fish and Wildlife Service on September 5, 2007 and concluded on November 30, 2007 with concurrence by the Service that no listed species occur within the project area and project implementations should have no effect on any endangered, threatened, candidate, or conservation agreement species listed species or their habitats. This determination is made based on the following:

- There are no listed species nesting within or adjacent to the project area.
- There is no designated critical habitat for Mexican spotted owl within the project area.
- California condor roosting sites have not been documented within the project area.

Forest Service Sensitive Species

Forest Service sensitive species are those likely to occur or have suitable habitat on forest lands and have been identified by the Regional Forester as a species of concern. These species are classified as sensitive due to significant or predicted downward trends in population numbers or density. There could also be a downward trend in habitat capability, reducing species distribution (Forest Service Manual 2670.5). Those sensitive species that may be affected directly, indirectly, or cumulatively by proposed actions were selected for further analysis. Because species cannot exist without their supporting habitats, impacts to both species and their habitats have been evaluated. Species known to occur on the North Kaibab Ranger District are listed in Table 37 and were evaluated using the best available science.

Table 37—Region 3 sensitive species occurring on the North Kaibab Ranger District

Common Name	Forest Habitat	Habitat in Project Area
Northern leopard frog	Aquatic habitat with submergent, emergent, and shoreline vegetation	No
Northern goshawk	Ponderosa pine, mixed conifer, and spruce-fir forests	Yes
Bald eagle	Large trees or cliffs near water with abundant prey	Yes
Peregrine falcon	All habitat types near cliffs and sufficient prey	Yes
Spotted bat	High cliff crevices near water sources	Yes
Allen's lappet-browed bat	Woodland and forest, often associated with cliffs and rocky slopes	Yes
Pale Townsend's big-eared bat	Caves and mines in woodland and forest	Yes
Kaibab least chipmunk	Coniferous forest	Yes
Kaibab squirrel	Ponderosa pine	Yes
Kaibab northern pocket gopher	High mountain meadows	Yes
House Rock Valley chisel-toothed kangaroo rat	Scattered juniper in sandy areas	No
Long-tailed vole	Meadows, sagebrush flats, and rocky slopes near or in coniferous forests	Yes

The northern leopard frog and House Rock Valley chisel-toothed kangaroo rat are removed from further analysis because historic and occupied habitats for these species are located well outside the project area. The remaining species on the list, with the exception of the northern goshawk, are grouped by like species and by similar determination of effects for the alternatives.

Affected Environment: Northern Goshawk

The northern goshawk occurs in coniferous forests throughout the western United States, Canada, and along the Sierra Madre Occidental in Mexico. The northern goshawk is a common breeding resident on the Kaibab Plateau within ponderosa pine, mixed conifer, and spruce/fir forests. The goshawk utilizes a variety of forest age classes, structural conditions, and successional stages (Reynolds et al. 1992). Home ranges of adjacent pairs may overlap, especially in areas where nesting populations are at or near saturation (Reynolds and Joy 1998). Goshawks commonly maintain alternate nest sites within their home range. Sometimes the same nest site is used in subsequent years, but often an alternate is selected.

Research indicates that the northern goshawk requires areas of mature forested habitat characterized by large trees, closed canopy cover, and an open understory for nesting and for use as a post-fledging family area. This same area is used by fledglings to learn to fly and forage (Reynolds et al. 1992, Crocker-Bedford and Chaney 1988, De Stafano and McCloskey 1997). Concern over the status and possible decline of the northern goshawk in the western United States prompted the development of the *Management Recommendations for the Northern Goshawk in the Southwestern United States* (RMNG, Reynolds et al. 1992). These recommendations are incorporated in the Kaibab National Forest Land Management Plan, as amended in 1996. Approximately 17 percent of the documented northern goshawk post-fledging family areas (28 PFAs) on the District are located within the Jacob-Ryan analysis area. The density of goshawk

territories in the project area is very high, resulting in several immediately-adjacent PFAs and overlapping foraging areas (see Figure 15).

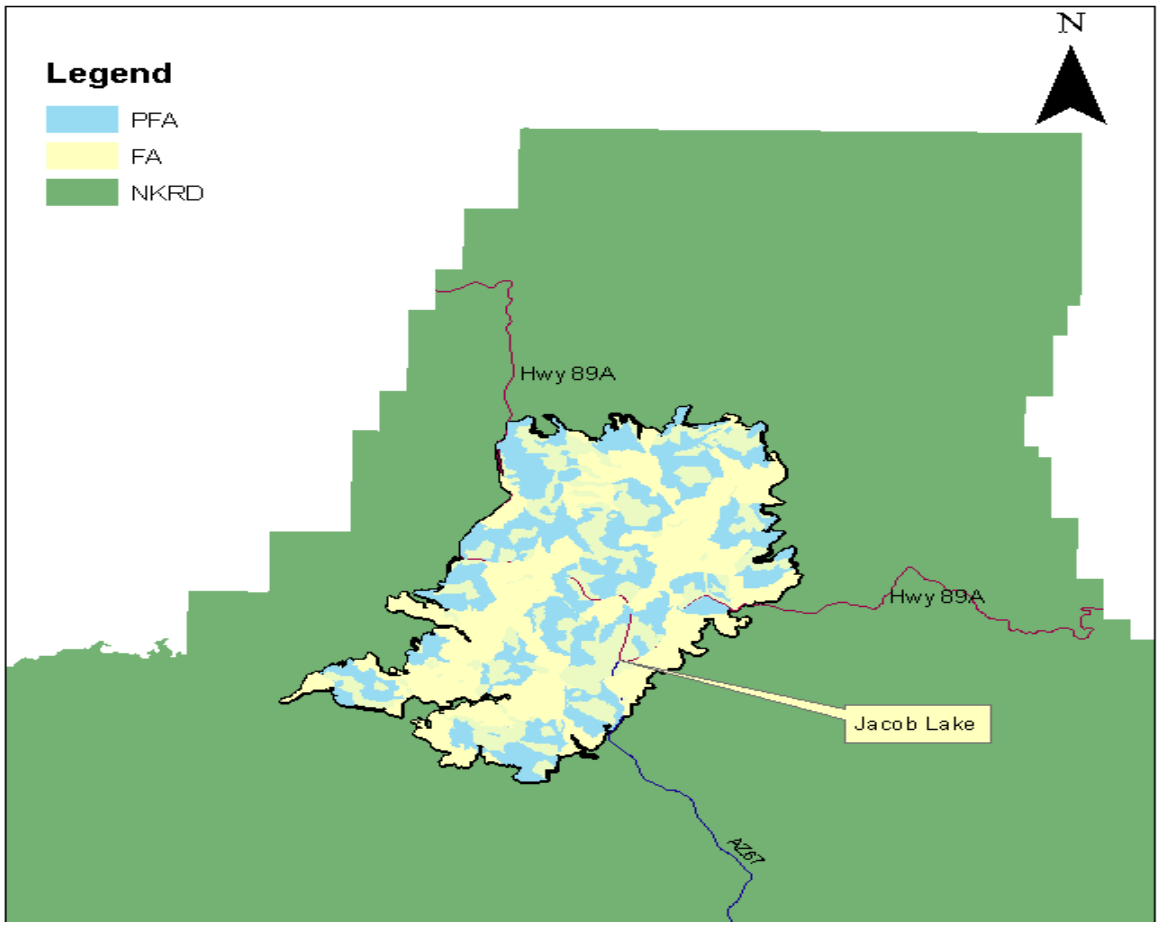

Figure 15—Post-fledging family and foraging areas within the Jacob-Ryan project

The Jacob-Ryan project was separated into treatment areas due to differing existing and desired conditions. Tree harvest methods and fire exclusion created dense uneven-aged stands. Differences between the existing numbers of trees per acre versus the desired number are described in Chapter 1.

Direct and Indirect Effects for Northern Goshawks

Alternative 1 – No Action

No direct effects are expected from the no-action alternative. Increases in tree density are expected in group size classes VSS 2 and VSS 3, further decreasing the vigor of individual trees. The additional stress placed on the trees increases susceptibility to dwarf-mistletoe infection, insect damage, and risk of a stand-replacing fire (see Fire and Silviculture section). Indirect effects of the no-action alternative include decreased habitat suitability and decreased foraging opportunities as the habitat becomes more homogeneous. The no-action alternative would leave the area at high risk for stand-replacing wildfire, which would negatively impact northern goshawk populations and their supporting habitats. This happened recently adjacent to the project area; the Warm Fire

caused overstory mortality in excess of 53 percent in goshawk PFA habitats (USDA 2007b). Four of eight known active nests were in areas characterized by high intensity crown fire and an estimated 7 nestling/fledgling goshawks were likely killed by the fire (R. Reynolds, personal communication – PR 63).

The greatest potential impact from the no-action alternative is the sustained and growing high risk of large-scale habitat loss for multiple species due to a wildfire. A considerable loss of species and associated habitat were lost in the Warm Fire. Some ground-dwelling species should return to the Warm Fire area within a couple of years. Given the lack of seed sources and harsh growing conditions, it will be decades to centuries before tree inhabitants return in normal numbers and this area is again suitable for goshawk nesting.

Alternative 2 – Proposed Action

Under the proposed action, all known goshawk nest sites have specific treatments designed to enhance existing nesting habitat while protecting the integrity of the vertical diversity. Treatment activities would be seasonally restricted to prevent disturbance at active nests.

This project was designed to move the project area closer to the desired conditions in the Forest Plan which were specifically developed to provide sustainable habitat for the northern goshawk and its prey. Treatments for this project include tree thinning up to 18 inches DBH, leaving all mature and large trees in place. Thinning would create clumps (up to 0.5 acre) and groups (up to four acres) of trees while maintaining interlocking canopies (see Appendix D, Figures 1 and 2). In the even-aged stands, treatments would focus on creating groups and openings by removing VSS groups occurring in quantities greater than the desired condition, mostly less than 12 inches DBH. Treatments for uneven-aged stands would focus on removing smaller sized trees to enhance tree groups and create openings while maintaining a 40 percent canopy cover (see Appendix D, Figures 3 and 4). The proposed action would open up the rooting zones and create openings which would provide increased diversity of the herbaceous understory as described by Moore et al. (2006), benefiting not only the goshawk, but also its diverse prey base.

Long-term beneficial effects for the goshawk include better habitat heterogeneity, foraging opportunities, and a reduction in the threat of habitat loss from stand-replacing wildfire. Smoke and noise disturbance during prescribed burning activities might result in short-term (immediate) direct effects to individuals. Indirect effects within five years for this species include habitat disturbance that could change prey species composition and populations.

Some goshawk prey species may be affected by the removal of mistletoe infected trees; however, infected large and mature trees that are often used by prey species for nesting, resting, and feeding would not be cut. The effects from dwarf-mistletoe treatments are short-term and are expected to only affect individual species such as tree squirrels.

Alternative 3 – Twelve-inch Diameter Limit

This alternative modifies Alternative 2 by limiting tree thinning and removal to trees up to 12 inches DBH. The effects on even-aged stands would be similar to those in Alternative 2; due to the limited number of trees over 12 inches (see Appendix D, Figures 1 and 2). Alternative 3 would leave stand density higher, resulting in higher susceptibility to insect and disease attacks, especially from bark beetles. This alternative would leave more trees that could potentially grow into VSS 5 and 6, but would not necessarily have the desired clump and group arrangement. An inability to thin trees between 12 and 18 inches would likely result in higher than desired density and reduced diameter growth in some areas, potentially resulting in fewer large trees over time.

Alternative 3 would not provide enough open area to facilitate root growth, seedling regeneration, or reduction in overall fire risk on the landscape (see Appendix D, Figures 3 and 4). The increased stand density and lack of size distribution could have potential long-term adverse effects arising from stressed and diseased tree stands posing a greater fire risk and, therefore, habitat loss.

Direct and indirect effects for this alternative would be similar to those in the proposed action, but would not as fully achieve the desired size-class distribution and arrangement called for in the Forest Plan. Habitat conditions would result in continuing relatively homogenous vegetation structure, similar to the no action alternative. Through time, prey species that depend on open habitat (e.g., flickers, chipmunks) and generalist species (e.g., Stellar's jays) would be expected to decrease in abundance. Prey species that require closed forest conditions would increase through time. However, limiting the overall variety of prey species would decrease resiliency of goshawks as they become more strongly linked to trends of individual species. For example, if effects of decreased precipitation led to decreased populations of red or Kaibab squirrels, goshawks would have fewer opportunities to switch prey species.

A twelve-inch diameter limit would limit progress towards improving forest health or treating mistletoe-infected trees. Mistletoe treatment in this alternative fails to meet the objectives of developing and maintaining healthy uneven-aged stands or moving the area toward a fire-adapted landscape.

Comparison of Action Alternatives for Northern Goshawk

Both action alternatives would reduce the potential risk of a large-scale wildfire. Alternative 2 would more closely achieve the objectives of restoring sustainable goshawk habitat. Both Alternative 2 and Alternative 3 would protect and enhance existing mature and old trees, making them available for goshawk nesting and rearing habitat. Alternative 2 would create a better growing environment for large, old trees by providing more open space for moisture and nutrient uptake. Decreasing competition allows individual trees as well as developing clumps of VSS 5 and 6 to grow larger faster, which would result in more a diverse vegetation structure, benefiting both goshawks and their prey species while reducing the risk of stand-replacing wildfire.

Cumulative Effects to Northern Goshawks

The cumulative effects analysis area for the northern goshawk is defined as 10 miles beyond the proposed project boundary. This allows analysis of goshawks within the action area and should include the majority of birds foraging within the project area, but nesting and fledging outside the project area. Ten miles was selected because it is the average distance traveled by dispersing goshawks. Given the lack of a more definitive distance in the literature, this estimate should be adequate to include foraging adult birds.

There has been very little vegetation management in the analysis area since about 1987. Goshawk habitat and territories overlap in the project area. The proposed action would create more diverse habitat, including an interspersion of openings and groups of variable aged trees, providing habitat for a variety of prey species. Increasing the overall prey base should benefit goshawk reproduction, particularly given the high densities of goshawks within the project area.

The Warm Fire destroyed thousands of acres of suitable habitat, including nesting areas and nestlings killed as a result of the fire. This probably had an immediate and lingering effect on established resident territories and the amount of available prey. Implementation of the proposed action protects and enhances mature and old-growth trees in the project area, creates greater goshawk foraging opportunities and starts converting about a third of the project area from even-

aged acres to uneven-aged forest habitat for northern goshawks. The proposed action is not expected to affect forest-wide population trends, but should increase suitable goshawk and prey habitat, eventually offsetting some of the detrimental effects of the Warm Fire.

The net effect of the proposed action, when combined with past, ongoing, and planned actions in and adjacent to the project area, would be beneficial for both the northern goshawk and its prey species.

Affected Environment: Bald Eagle

Bald eagles occur in Arizona as either breeding populations or as winter migrants in close proximity to water (Grubb et al. 1994). They avoid areas with nearby human activity and development (Buehler 1991). Several hundred wintering eagles arrive in the central and northern portion of the State between late October and early November. Wintering eagles generally leave the area in early- to mid-April. Bald eagle populations in the 1980s were increasing in Arizona (Forbis 1988). The population increases nationwide is attributable to their protection, active management, and enhanced reproduction following the ban on DDT (Matthews and Moseley 1990).

No bald eagle nests have been documented on the North Kaibab Ranger District and the eagles occur only as an occasional winter migrant or visitor. A limited number of individuals are typically seen each year in open meadow habitat or along the highways where they find and feed on dead livestock or road-killed deer. Occasionally, individual eagles are observed during the winter at Big Springs Administrative Site, where they feed on non-native rainbow trout from the ponds. There is very limited suitable winter foraging habitat on the District, given the limited water resources. Nankoweap in the Grand Canyon to the southeast of the District is a known area for winter congregation of bald eagles, where they are observed feeding on fish. Forest Plan and National Bald Eagle Management Guidelines would be followed to allow for snag recruitment and retention during all phases of the project (see Appendix H).

Affected Environment: Peregrine Falcon

The US Fish and Wildlife Service delisted the peregrine falcon as an endangered species in 1999. Trends and status are still under a de-listing review. Essential habitat for peregrine falcon includes rock cliffs for nesting and a large foraging area. They breed in Arizona wherever sufficient prey is available near cliffs. Areas such as the Mogollon Rim, the Grand Canyon, and the Colorado Plateau contain most of Arizona's breeding peregrines. There are no known cliffs to provide potential nesting sites within the Jacob-Ryan project area. The closest known peregrine eyrie is located at Oak Canyon, approximately two miles to the southwest of the project area.

Direct and Indirect Effects on Bald Eagles and Peregrine Falcons

Alternative 1 – No Action

Under the no-action alternative, habitat conditions for the bald eagle and peregrine falcon would remain on the current trajectory. The forest would become increasingly dense with smaller size-class trees. The inherent risk of a stand-replacing wildfire in the dense forest could limit bald eagle roosting and foraging habitat as well as foraging habitat for the falcon.

Alternatives 2 and 3

Eagles avoid areas associated with human activity and could be temporarily displaced from foraging areas by mechanical treatments and prescribed burning. Indirect effects to the bald eagle may occur from the loss of snags during prescribed fire. While fire created snags have short time

lines before falling, they do create habitat for 5 to 10 years. In addition, the Forest Plan will be followed, which are usually created when fire treatments remove older, weaker snags. No direct effects are expected to affect the peregrine as no thinning will occur within two miles of nesting areas. Smoke may temporarily displace roosting bald eagles and may temporarily affect nesting falcons, depending on the air currents in the Grand Canyon. Prey species for the peregrine falcon may be affected on a short-term basis due to the mechanical disturbances. None of the action alternatives or their associated activities would have an adverse effect on the population trends for either the bald eagle or the peregrine falcon. The expected diversity in understory vegetation should increase insect populations, benefiting swifts, one of the primary prey species of peregrine falcons in northern Arizona (Ellis et al. 2004). Prey species are expected to increase providing greater diversity and abundance for foraging raptors.

Bald eagles and peregrine falcons have their primary roosting and nesting areas well outside the project area. They use the project area for roosting and foraging, therefore disturbances are expected to have a low degree of effect on these birds.

Although the action alternatives may temporarily displace individuals or create changes in forage availability, neither of the action alternatives are likely to have adverse effects on these two Forest Service sensitive wildlife species that would result in a loss of species viability in the planning area or cause a trend to federal listing.

Affected Environment: Spotted Bat

The spotted bat is distributed across large areas of western North America from southern British Columbia to the central Mexican state of Quertaro. These bats are patchily distributed and only locally abundant, even though they have a widespread geographic distribution. They are typically common at sites near high cliffs, roosting in rock cliffs but foraging across much of the Kaibab Plateau. Radio tracking research during August 1995 and July 1996 was conducted with 12 spotted bats captured on the District south of the Jacob-Ryan project area (Rabe et al. 1998a). Most of the bats were re-captured over small ponds in sub-alpine meadows and one spotted bat was tracked to its day roost in the cliffs above the Colorado River. Results of numerous studies summarized by Luce et al. (2007) show that spotted bats prefer foraging in open areas, often near water. Spotted bats are not known to roost or forage within the project area.

Affected Environment: Allen's Lappet-Browed Bat

Allen's lappet-browed bat occurs throughout most of Arizona (except the southwestern deserts) into Mexico. Most Arizona captures for this bat have been in woodlands or coniferous forests, often associated with cliffs and rocky slopes. Males often roost in cliffs and rocky slopes, while females roost in large old ponderosa pine snags that have exfoliating bark for roosting sites (Rabe et al. 1998b). These bats are insectivorous and can feed during flight, but they feed mostly by gleaning moths and stationary insects from surfaces. This species was rarely captured during extensive mist-netting surveys on the District from 1994 through 1998. Capture locations were Indian Hollow Tank, West Lake, Big Springs, and Warm Springs Lake. Forest Plan guidelines would be followed to promote retention and recruitment of large diameter snags that provide bat roosting sites (see Appendix H).

Affected Environment: Pale Townsend's Big-Eared Bat

This species ranges through much of the western, midwestern and eastern United States and is widespread in Arizona. These bats are found in low deserts, woodlands and coniferous forests. Population concentrations are strongly correlated with the presence of caves and abandoned mine

shafts in which they roost. The diet for the pale Townsend's big-eared bat consists of 90 percent moths. They take prey from leaves and while in flight along forest edges (Arizona Game and Fish Department 2003). There are no known roost sites in the project area; however they have been captured elsewhere on the Kaibab Plateau while foraging in open meadows over stock tanks.

Direct and Indirect Effects on Spotted, Allen's, and Pale Townsend's Bats

Alternative 1 – No Action

The no-action alternative would not directly affect any of the three bat species because no actions would be undertaken under this alternative. Wildfires could have an indirect effect on foraging availability for the three bats and destroy roosting sites for the Allen's lappet-browed bat.

Alternatives 2 and 3

Maternity colonies of the Allen's lappet-browed bat are easily disturbed, and disturbance often results in abandonment. Snag roosting bats tend to move between multiple roost sites and will move their pups with them. This project could negatively impact Allen's lappet-browed bats, but the degree of impact is difficult to estimate. Given that bats can move between roost sites, large snags will be retained, and, at the District scale, a limited area will be treated at any one time, the project is not expected to move snag roosting species towards listing. Prescribed burning may also result in temporary loss of foraging habitat for the bat species, but over time, burn treatments would result in increased grasses, herbaceous plants, and shrubs, increasing forage opportunities.

The primary roosting and nesting areas for spotted and Pale Townsend's bats are well outside the project area or in caverns and their foraging areas are usually close to water sources and meadows. They use the project area primarily for resting or foraging, so any disturbance is expected to have a low degree of effect on these bat species.

The action alternatives may temporarily displace individuals or create a change in forage availability, but is not likely to result in a loss of species viability in the planning area, nor cause a trend to federal listing for the spotted bat, Allen's lappet-browed bat or the pale Townsend's big-eared bat.

Affected Environment: Kaibab Least Chipmunk

The Kaibab least chipmunk is a subspecies of the least chipmunk. Least chipmunks occur throughout the western United States, upper Midwest, and throughout Canada. The Kaibab least chipmunk occurs on the Kaibab Plateau in north central Arizona, northward into Utah, Wyoming, Idaho, Montana, and east into Colorado (Verts and Carraway 2001). This subspecies occurs as a disjunct population on the Kaibab Plateau of north central Arizona. These small diurnal chipmunks prefer spruce/fir forests, but occur in other habitat types. They are usually found in open places on the forest with rocky areas within moist or damp terrain. Summer dens are typically in hollow logs, stumps, in rock piles, or under debris. Least chipmunks feed on and store a variety of small seeds that they can reach from the ground or by climbing bushes. They also use fleshy fruits and berries when available. Habitat recommendations for chipmunk in the goshawk guidelines include maintaining two snags and 5-7 tons of downed woody debris per acre.

Direct and Indirect Effects on the Kaibab Least Chipmunk

Alternative 1 – No Action

There would be no direct effects under the no-action alternative because no activities would be undertaken. Indirect effects include the increased risk of stand-replacing wildfire.

Alternatives 2 and 3

Treatments under the action alternatives may initially reduce or displace chipmunk populations, but populations have been known to recover to numbers at or above pre-project levels, possibly due to increases in forage and cover (Goodwin and Hungerford 1979). Fire usually burns with a natural mosaic or patchiness due to microclimates under some trees. The types and amounts of fuels involved in any prescribed burn may reduce some downed woody debris, but it is not likely to remove it all. Chipmunks quickly adapt to the transformed environments because they are a generalist species.

Affected Environment: Kaibab Squirrel

The Kaibab squirrel is a geographically isolated subspecies of the Abert's squirrel. This squirrel occurs only on the Kaibab Plateau in extreme north central Arizona as an obligate resident of ponderosa pine forests (Dodd et al. 2003). Kaibab squirrels are highly dependent upon ponderosa pine habitat and occur in good numbers throughout the project area. They nest in ponderosa pines; they feed on the bark, staminate flowers, buds, and seeds, and use the interlocking crowns as travel corridors and escape routes. Other foods include fungi, mistletoe, acorns, bones, antlers, insects, and occasionally small amounts of grasses and shrubs. Nests are usually located in the branches of large pines from about 16 to 90 feet above the ground (Hoffmeister 1986). Nesting also occurs in witches brooms, a branch deformity in trees infected with dwarf-mistletoe. The probability of squirrel use increases as the number of branches within a broom and tree height increase. Selected nest trees are usually in the middle of tree groups with interlocking crowns. Thinning guidelines are designed to protect and sustain a wide variety of species, including the Kaibab squirrel. A key component of current thinning practices is to retain or create clumps and groups of trees with interlocking canopies.

Integrated or even-aged stand management previously described can have a direct negative effect on Kaibab squirrels of the North Kaibab Ranger District (William Hurst 2008, personal communication – PR 64). Current vegetation management direction is to return ponderosa pine forests to conditions that resemble pre-settlement conditions. Strict presettlement prescriptions may reduce canopy closure, tree density, diversity, and patchiness important to canopy-dependent wildlife (Chambers and Germaine 2003, Dodd et al. 2003). Thinning guidelines in the Forest Plan promote clumps and groups of trees with interlocking tree crowns and irregular spacing between tree groups. These vegetation treatments are designed to protect and sustain a wide variety of species, including the Kaibab squirrel. Dodd et al. (2003) found that interlocking canopy is related to squirrel density and recruitment at the patch scale. Patton (1975) reported that 92 percent of the squirrel nests were found in trees growing inside a group, and 75 percent of those groups had three or more interlocking canopy trees. An interlocking canopy is the foundation that provides nesting habitat, travel corridors, and helps maintain soil moisture for fungal growth on the forest floor.

Direct and Indirect Effects on the Kaibab Squirrel

Alternative 1 – No Action

There would be no direct effects under the no-action alternative. Indirect effects include the increased risk of stand-replacing wildfire, as well as overstocked stands prone to disease and insect infestation, with resultant decreased cone production.

Alternatives 2 and 3

Thinning under the two action alternatives would result in a mosaic of structural age classes, creating clumps and groups of trees with interlocking crowns. Overall, crown connectivity could

be reduced during the creation of openings between the groups and clumps. These conditions may temporarily cause declines in squirrel populations. However, squirrel numbers would likely remain higher than they were in the presettlement period when forests were more open and park-like. Other direct effects are short-term disturbances to nest sites during thinning and prescribed burning activities. These effects are expected to be limited in area and duration.

Indirectly, truffle production may be reduced due to a decrease in canopy closure following stand treatments. This effect is expected to be short-term since the primary objective of vegetation management activities is to promote natural tree groupings with interlocking crowns and high canopy cover. Activities associated with dwarf-mistletoe treatment encompass only about 4 percent of the total project area. The effects from those treatments are expected to be limited to individuals. Anticipated long-term increase in habitat sustainability and the reduced risk of wildfires are potential beneficial effects within the project area.

Affected Environment: Kaibab Northern Pocket Gopher

There are more than 55 subspecies of northern pocket gophers. They occur throughout much of western United States and into Canada. The Kaibab subspecies occurs only on the Kaibab Plateau of north central Arizona. This subspecies inhabits the soils in high elevation meadows surrounded by spruce/fir or ponderosa pine. Grasses, weeds, and shrubs occurring in those meadows provide most of the pocket gopher's food requirements.

Affected Environment: Long-Tailed Vole

The long-tailed vole occurs throughout much of western United States, British Columbia, and into Alaska. They occur in isolated populations in Arizona, including the Kaibab Plateau in north central part of the state. In Arizona, they inhabit meadows, grass-valleys, and clearings in forests. They also inhabit sagebrush flats and rocky slopes near or in coniferous forests. Long-tailed voles on the District are commonly found in grassy areas around springs or swamps adjacent to lakes (Hoffmeister 1985). The vole diet consists of fruits, seeds, and herbaceous plant material.

Direct and Indirect effects on the Kaibab Northern Pocket Gopher and Long-tailed Vole

Alternative 1 – No Action

There would be no direct effects under the no-action alternative for the Kaibab northern pocket gopher and the long tailed vole. Indirect effects include the increased risk of stand-replacing wildfire for both species. These ground-dwelling mammals would experience continued forest encroachment into grassy meadows resulting in a loss of habitat and foraging area for the pocket gophers and voles.

Alternatives 2 and 3

These two ground mammal species could experience short-term direct effects from disturbances to nest sites during vegetation treatments and prescribed burning activities. These effects are expected to be limited in area and duration. Prescribed burning may disrupt gopher and vole activities and some individuals may be lost. Burning would also result in a temporary loss of cover and could alter food source availability for these species. A beneficial by-product of the treatments would be the increased vigor and distribution of grasses and herbaceous plants, providing greater foraging opportunities. Vegetation treatments are expected to have positive indirect effects in the long term by increasing overall habitat sustainability and reducing the risk of wildfires.

Cumulative Effects on the Kaibab Squirrel, Kaibab Least Chipmunk, Kaibab Northern Pocket Gopher and Long-tailed Vole

The Warm Fire displaced or destroyed many species and thousands of acres of associated habitat. Much of that burned habitat could be unusable or dysfunctional for decades to come. Mechanical treatments and prescribed burn activities in the project area could temporarily displace individual species, adversely affecting their nesting and foraging activities in the short term.

The majority of past vegetation management in the project area occurred 20 years to 30 years ago. Livestock use was reduced in 2001, as much as 30 percent in some areas. Consequently, with the exception of a few wildfires and blowdowns, the project area has provided a fairly stable habitat for wildlife. About a third of the project area is congested with even-aged young forest stand structures. The proposed action would be the first attempt or entry into these stands to create uneven-aged structures. The primary effect on wildlife would be how species adapt to the new openness of the stands. The same change in habitat structure could provide additional forage opportunities, while at the same time reducing hiding cover. Treatment activities in uneven-aged stands enhance wildlife habitat suitability and stability by creating additional foraging areas and enhancing forest health. The treatment activities also move the project area toward a fire-adapted landscape.

The action alternatives should not incur any detrimental impacts to these Forest Service sensitive wildlife species. Alternative activities may temporarily displace individuals or create a change in forage availability, but this is not likely to result in a loss of species viability in the planning area, nor cause a trend to federal listing for the Kaibab least chipmunk, Kaibab squirrel, Kaibab northern pocket gopher, or the long-tailed vole.

Management Indicator Species (MIS)

The 1982 regulations enforcing the 1976 National Forest Management Act require all forests to designate certain species to serve as management indicators (MIS), not only for the selected

species but for a host of other species with similar habitat requirements. Management indicator species are selected from one of the following five categories: (1) Endangered or threatened status; (2) species commonly hunted, fished, or trapped; (3) non-game species of special interest; (4) species with special habitat needs that may be significantly influenced by planned management programs; and (5) species whose population changes are believed to indicate effects of management activities on other species. A working draft of Forest-wide indicator species assessment, *Management Indicator Species of the Kaibab National Forest: Population Status and Trends* (USDA Forest Service 2008) (hereafter referred to as the Kaibab MIS Assessment), summarizes current knowledge of population and habitat trends for species identified as MIS for the Kaibab National Forest. Table 38 displays all MIS species that occur in or adjacent to Geographic Area 13 (formerly Ecosystem Management Area 13) and identifies their associated habitat type and seral stage.

Table 38—Management indicator species for the Kaibab National Forest

Common Name	Forest Habitat	Vegetation Characteristics
Northern goshawk	North and South Kaibab NF: ponderosa pine, mixed conifer, spruce/fir, and aspen forests.	Late-seral ponderosa pine
Hairy woodpecker	North and South Kaibab NF: ponderosa pine, mixed conifer, spruce/fir, and aspen forests; pinyon/juniper woodlands.	Snag in ponderosa pine, mixed conifer, and spruce/fir
Juniper titmouse	North and South Kaibab NF: pinyon/juniper woodlands.	Late-seral pinyon/juniper, snags in pinyon/juniper
Pygmy nuthatch	North and South Kaibab NF: ponderosa pine forests.	Late-seral ponderosa pine
Wild turkey	North and South Kaibab NF: ponderosa pine, mixed conifer, aspen forests; pinyon/juniper woodlands.	Late-seral ponderosa pine
Red-naped sapsucker	North and South Kaibab NF: aspen forests.	Late-seral aspen, snags in aspen
Mule deer	North and South Kaibab NF: all forest and woodland habitat types, savannahs, and grasslands.	Early-seral aspen, pinyon/juniper
Red squirrel	North and South Kaibab NF: mixed conifer and spruce/fir forests.	Late-seral mixed conifer and spruce/fir
Kaibab squirrel	North Kaibab NF: ponderosa pine forests.	Early-seral ponderosa pine

The Jacob Ryan project area contains about 26,000 acres of ponderosa pine habitat, 819 acres of pinyon/juniper, less than 40 acres of aspen, and no acres in mixed-conifer. No treatments are proposed in any of these habitat types, therefore a "no effect" determination is made for habitats in pinyon/juniper, aspen and mixed conifer. A "no effect" determination is also made for species specifically associated with those habitat types. Therefore, the following species are removed from further analysis: juniper titmouse, red-naped sapsucker, and red squirrel. The remaining effects analysis is limited to the ponderosa pine habitat type and its associated species. The Kaibab National Forest has about 521,000 acres of ponderosa pine habitat forest wide. Treatments proposed within the Jacob Ryan project area amount to less than 5% of the total ponderosa pine forest wide.

Northern Goshawk

The Kaibab Plateau holds one of the most concentrated populations of northern goshawks known in North America. The northern goshawk is classified as a Forest Service sensitive species and is a

management indicator species for the Kaibab National Forest. It was selected to represent species using late-seral ponderosa pine habitat. Area goshawks are widespread and relatively abundant. Population trends are difficult to determine and could be declining in some areas, but there is no hard evidence of a considerable decline overall (NatureServe 2007). There are over 100 northern goshawk territories on the North Kaibab that have been monitored yearly since 1991. Potential impacts by alternative and additional species information are presented in the sensitive species section of this report and population trend data at the Forest level is summarized in the 2008 Kaibab MIS Assessment (pages 24–31).

Direct and Indirect effects on the Northern Goshawk

Alternative 1 – No Action

Under the no-action alternative, stands with high tree density would remain stressed, decreasing growth and increasing susceptibility to drought and insect infestations by bark beetles and mistletoe. Indirect effects of the no-action alternative are decreased habitat suitability, decreased foraging opportunities, and a continued risk of habitat loss from stand-replacing fire. The largest effect would be in the reduced understory, affecting herbaceous-dependent prey species. Current trends for the northern goshawk and its habitat, although stable, are likely to diminish under the no-action alternative.

Alternatives 2 and 3

The approximate 26,000 acre project area represents about 5 percent of the total ponderosa pine cover type Forest-wide. While age and structure of ponderosa pine forests is changing through time across the Kaibab National Forest, total acres are likely to remain constant. Thinning of such a small portion of this habitat type would be insufficient to alter northern goshawk habitats or population trends Forest-wide for this species. Seasonal restrictions and specific implementation guidelines for all action alternatives protect this species, their nesting areas and post-fledging family areas from potential adverse direct effects. Goshawk prey species would experience short-term habitat cover changes, but they should also experience greater forage availability over time. The new open areas should provide additional prey species availability, improved habitat suitability and reduced threat of stand-replacing fires.

Hairy Woodpecker

The hairy woodpecker was selected as a management indicator to represent species affected by the snag component of the ponderosa pine, mixed conifer, and mixed conifer with aspen patches on the Kaibab National Forest. Hairy woodpeckers are strongly associated with burn areas (Covert-Bratland et al. 2006). They are an important historical component of frequent fires in northern Arizona's forests (Covington et al. 1997). Several studies have shown that hairy woodpeckers select dead and dying trees for foraging more often than live trees. They use cavities for roosting and winter cover in forests with dense canopies and may also excavate new cavities during the fall for roosting (Sousa 1987). Forest Plan guidelines would be followed to provide retention and recruitment of snags sufficient for hairy woodpecker nesting and foraging. Potential management impacts and population trend data forestwide for this species are summarized in the Kaibab MIS Assessment (pages 38–39).

The Jacob Ryan project area represents 5 percent of the ponderosa pine community type Forest-wide and is only one of the usable habitat types for this species. The thinning in the proposed action constitutes a small portion of total Forest-wide habitat and would be insufficient to alter habitats or population trends for this species Forest-wide.

Direct and Indirect Effects on the Hairy Woodpecker

Alternative 1 – No Action

Under the no-action alternative there would be a slight decrease in snags over the planning period. The opportunity would not exist to increase the number of snags in the project area and could decline below recommended levels. However, the overall trend for hairy woodpecker populations and snag habitat would not detrimentally change at the District or Forest-wide level as a result of implementing this alternative.

Alternatives 2 and 3

Direct effects would include temporary disruption of normal woodpecker activity during mechanical thinning and prescribed burning. There are great foraging opportunities in acres adjacent to the project area created by the Warm Fire.

The effects are similar between alternatives and therefore any trend changes are expected to be similar. District population levels are expected to remain higher than Forest or historic levels with implementation of the proposed alternatives. Pope (2006) found a five-fold increase in population density in areas following low-intensity burns. The approximate 26,000 acre project area represents about 5 percent of the total ponderosa pine cover type Forest-wide. While age and structure of ponderosa pine forests is changing through time across the Kaibab National Forest, total acres are likely to remain constant. Hairy woodpecker numbers would remain stable at the Forest level because snag densities and other components of the ecosystem used by this species would not change appreciably from this project.

Cumulative effects for hairy woodpecker

The proposed partial harvesting of the Warm Fire acres could temporarily reduce foraging opportunities for this woodpecker. Creating uneven-aged stands following northern goshawk habitat guidelines, including snag retention during implementation, concurrently provides suitable habitat for the hairy woodpecker. The proposed action and Alternative 3 also maintain the current status for mature and old-growth trees, protecting the existing canopy cover preferred by this species.

Current forest management practices recognize the value of snags and, with the exception of hazard trees, are not selected for removal and sometimes even created during vegetation management activities. Hazard trees created by the Warm Fire already removed by the Arizona Department of Transportation along Highways 89A and 67 as well as those being removed along Forest Service roads would have negligible affect on use by the hairy woodpeckers. Both action alternatives improve forest habitat conditions in varying degrees, including mature and old-growth trees, benefiting populations and habitat trend for the hairy woodpecker, an important prey species of the northern goshawk.

Pygmy Nuthatch

The pygmy nuthatch is one of the most abundant species inhabiting ponderosa pine forests (Kingery and Ghalambor 2001). Pygmy nuthatches are selected to represent species using late-seral ponderosa pine habitat. They are primary cavity nesters. They excavate nests in dead or well rotted wood, but may also use existing natural or abandoned cavities in other conifers or aspen (Kingery and Ghalambor 2001). Potential management impacts and Forest-level population trend data for this species are summarized in the Kaibab MIS Assessment (pages 53-56). Forest

guidelines provide for snag retention and recruitment during management activities sufficient for pygmy nuthatch nesting requirements.

The approximate 26,000 acre project area represents about 5 percent of the total ponderosa pine cover type Forest-wide. While age and structure of ponderosa pine forests is changing through time across the Kaibab National Forest, total acres are likely to remain constant. The amount of thinning of predominantly small diameter trees would be insufficient to alter the Forest-wide habitat or population trend for this species. Pygmy nuthatches have a stable population trend on the Kaibab National Forest.

Direct and Indirect Effects for Pygmy Nuthatch

Alternative 1 – No Action

Pygmy nuthatches are secondary cavity-nesters requiring dead trees. The continuance of current forest conditions would likely maintain suitable snags levels and provide sufficient pygmy nuthatch habitat. Elevated fire threat could affect pygmy nuthatches in different ways: moderate-severity fires could increase pygmy nuthatch populations, whereas high-severity fires would decrease nuthatch populations (Dwyer and Block 2000). Fire-created snags do not have the longevity of snags that develop from other sources. The effects from the no-action alternative are not likely to influence Forest-wide trends for the nuthatch.

Alternatives 2 and 3

Treatments from any of the action alternatives would open current tree and canopy conditions, reduce threats from insects, disease, and fire, as well as foster and protect mature and old-growth trees. The Kaibab Forest Plan directs that two snags per acre be provided in goshawk habitat in ponderosa pine forests. Plan direction should ensure snag levels that sustain pygmy nuthatches.

Potential direct effects to this species include short-term disturbance and displacement during thinning and prescribed burning activities. However, disturbance would be limited due to the use of goshawk guidelines that require buffering and limiting noise-producing activities during the nesting and fledging seasons.

Under both alternatives, the number of trees per acre decreases slightly after treatment and then increases slowly over time. Overall, there would be negligible differences in trees per acre between alternatives in smaller tree age-classes. The number of mature and old-growth trees would remain stable or increase after implementing Alternatives 2 and 3. The expected change in mature and old-growth ponderosa pine numbers used by pygmy nuthatches is not likely to yield a measurable change in forest wide ponderosa pine habitat quality or quantity. The vegetation thinning and low-intensity prescribed burning with both action alternatives would benefit pygmy nuthatches by providing increased herbaceous forage and ground cover, and would be insufficient to alter the Forest-wide habitat or population trend for this species.

Wild Turkey

Turkeys were chosen to represent use of late-seral ponderosa pine forests as well as being an economically and socially important species. Currently, wild turkeys occur throughout most of the state's forested regions, including the Kaibab Plateau. Wild turkeys were introduced onto the Kaibab Plateau and are now one of the State's most productive turkey populations. Wild turkeys prefer areas that contain a diversity of vegetative structures and openings, which provide for a variety of activities such as nesting, feeding, loafing, and roosting. Wild turkeys are ground-nesting birds. Steep slopes are usually a feature associated with nesting; nests may be located near

or next to landscape features such as rocks, cliffs, or the uphill side of trees (Wakeling et al. 1998). Nests can also be located near or within slash, brushy cover, or next to stumps or downed logs (Mollohan et al. 1995). Tom and hen turkeys without broods roost overnight in trees to avoid predators. Tree roost habitat is found within continuous stands of timber and is ideally comprised of mature, open-crowned trees. Mature pine can provide good roosting cover. Ground roosting is most critical to hen turkeys during the first three to four weeks of brood rearing. Hens with young roost under large trees within forests containing a dense understory that adequately conceal the birds (Mollohan et al. 1995). Wild turkeys feed in relatively open areas under forest canopy or small meadows that contain a diversity of ground cover, including nut-producing trees such as oaks. Potential management impacts and forest level population trend data for this species are summarized in the Kaibab MIS Assessment (pages 63–64).

Direct and Indirect Effects for Wild Turkey

Alternative 1 – No Action

There are no direct effects expected to turkeys under the no-action alternative. The estimated trees per acre would increase slightly over the planning period under this alternative. Potential negative indirect effects would include reduced herbaceous and shrub cover through competition and shading. Forest-wide changes to habitat would be minimal; therefore, minimal changes would be expected in turkey population numbers. Habitat quality would decline marginally through time as nuts, berries, and seeds become less available, hiding cover decreases, and brooding areas diminish. Consequently, detectable change in turkey population numbers is not expected at the Forest level.

Alternatives 2 and 3

Potential direct effects to this species under the proposed action alternatives include short-term disturbance and displacement during thinning and prescribed burning activities. However, disturbance would be limited due to goshawk management guidelines that limit noise-producing activities in the nesting season for both goshawk and turkeys.

Under both action alternatives, the number of trees per acre decreases slightly after treatment and then slightly increases over the planning period. Overall, there would be negligible differences in trees per acre between alternatives in smaller tree age classes. The number of mature and old-growth trees would remain stable or increase after implementing Alternatives 2 and 3. The expected change in mature and old-growth ponderosa pine numbers used by wild turkeys is not likely to yield a measurable change in populations or habitat quality or quantities. Actually, vegetation thinning and low-intensity prescribed burning should benefit turkeys by providing increased herbaceous forage and ground cover. The proposed management actions are not likely to affect population trends for this species.

Thinning under either action alternative would result in a mosaic of interspersed clumps and groups of trees with interlocking crowns, open areas for foraging, and downed woody debris for nesting sites. The approximate 26,000 acre project area represents about 5 percent of the total ponderosa pine cover type Forest-wide. While age and structure of ponderosa pine forests is changing through time across the Kaibab National Forest, total acres are likely to remain constant. This project will not affect forest wide trends in ponderosa pine habitat or turkey populations.

Mule deer

Mule deer were selected as an MIS because they are economically important and represent species using early-seral stages of aspen and pinyon/juniper habitats. Mule deer are a generalist species

that also use ponderosa pine, mixed-conifer, woodland, and chaparral habitats. Forage items mostly consist of woody browse (Hoffmeister, 1986). Mule deer occur across the Kaibab National Forest, but are especially important on the North Kaibab, much of which is within the boundaries of the Grand Canyon Game Preserve. The North Kaibab deer herd is famous for providing quality hunts and has a long history of management aimed at promoting large numbers of deer. Data from the North Kaibab indicate an increasing trend since the early 1990's.

Direct and Indirect Effects for Mule Deer

Alternative 1 – No Action

No direct effects are expected to mule deer from the no-action alternative. Indirect negative effects from this alternative include reduced understory browse and herbaceous cover and increased risk of wildfire. The current trends for mule deer and associated vegetation would not change in the short term compared to those reported in the 2008 Kaibab MIS Assessment.

Alternatives 2 and 3

Potential negative direct effects to mule deer under the action alternatives include the short-term displacement of mule deer from activity areas during thinning operations and prescribed burning activities. Positive indirect effects include the enhancement of forage within the ponderosa pine habitats following management activities. Improvement of forage within all treatment areas would slightly reduce grazing pressure on deer forage, but would not lead to a change in trends for animals or forage at the Forest level. The approximate 26,000 acre project area represents about 5 percent of the total ponderosa pine cover type Forest-wide. While age and structure of ponderosa pine forests is changing through time across the Kaibab National Forest, total acres are likely to remain constant. This project will not affect forest wide trends in ponderosa pine habitat or mule deer populations.

Tassel-Eared (Kaibab) Squirrel

The Kaibab squirrel is designated as a management indicator species for early seral stage ponderosa pine forests. However, this squirrel uses a variety of age classes and research has shown strong habitat associations with mature ponderosa pine for nesting, foraging, and movement. Potential management impacts and Forest-wide population trend data for this species are summarized in the Kaibab MIS Assessment (pages 88–91). The Kaibab squirrel is also a Forest Service sensitive species. Effects of the alternatives, along with additional species information, are described in the sensitive species portion of this document. The approximate 26,000 acre project area represents about 5 percent of the total ponderosa pine cover type Forest-wide. While age and structure of ponderosa pine forests is changing through time across the Kaibab National Forest, total acres are likely to remain constant. This project it not expected to affect trends in ponderosa pine habitat or in Kaibab squirrel populations forest (District) wide.

Migratory Birds

Executive Order 13186 was enacted to ensure federal agencies protect migratory birds through project design that limits adverse impacts on migratory bird resources and assures that migratory bird species receive consideration in the decision-making process. The National Forest Management Act requires that Forest Plans "preserve and enhance the diversity of plant and animal communities, so that it is at least as great as that which can be expected in the natural forest (36 CFR 219.27)." Furthermore, implementation regulations specify that "fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native

vertebrate species in the planning area." Current direction from the Forest Service Southwestern Regional Office to meet the objectives of Executive Order 13186 is to address migratory birds by analyzing potential effects to (1) priority bird species identified in the *Arizona Partners in Flight Bird Conservation Plan* (Latta et al. 1999); (2) Important Bird Areas (IBAs) identified through the Audubon Society IBA program; and (3) known important or unique avian over-wintering areas. Current direction also requires that the unintentional take of the proposed action be identified.

The Arizona Partners in Flight (APIF) established the priority species of concern concept (Latta et al. 1999). Partners in Flight selected the priority species for the ponderosa pine habitat type in Arizona and only birds associated with that habitat type will be analyzed. Four species have been identified: northern goshawks, olive sided flycatchers, Cordilleran flycatchers, and purple martins. Likewise, important bird areas (IBAs) administered by the National Audubon Society include geographical areas considered unique or important to bird populations on a state-by-state basis. Sixteen IBAs have been established in Arizona. None are designated or nominated within or adjacent to the Kaibab National Forest. Therefore, they are removed from further discussion.

Finally, important locations where large concentrations of birds gather for migration and/or over-wintering generally consist of large wetlands or bodies of water where waterfowl, shorebirds, or raptors congregate. There are no known or potentially important over-wintering areas on the District because wetland areas on the Kaibab Plateau are few and limited in size. Some small water sources are present, such as natural lakes, dirt tanks, and other developed waters sources. They may provide over-wintering habitat on a very limited scale. However, no large concentrations or unique bird species over-winter on the District or within the project area. Therefore, over-wintering areas are removed from further discussion. Some birds that are present in the project area might temporally be displaced during implementation, but they would return to the area at project completion.

Northern Goshawk

The breeding bird survey (BBS) for Arizona and Forest-wide shows a positive population trend from 1968 through 2006 (Sauer et al. 2007). However, this data may be questionable due to the following: (1) The regional abundance is less than 0.1 birds per route (very low abundance), (2) the sample is based on less than five routes for the long term, or is based on less than three routes for either subinterval (very small samples), or (3) the results are so imprecise that a 5 percent per year change would not be detected over the long term (very imprecise). However, the above-mentioned positive population trend is further substantiated by the data collected by Richard Reynolds of the Rocky Mountain Research Station during 1996 through 2007.

Olive-sided Flycatcher

Olive-sided flycatchers prefer forest edges with natural or human-made openings in spruce/fir, mixed conifer, and ponderosa pine forest types. They nest high in coniferous trees and forage primarily on flying insects. Habitat management includes providing forest openings and uneven-aged forest structure, and retention of tall snags or dead-topped trees during salvage operations (Latta 1999). Breeding bird survey data from the Western Region shows a downward trend for this species from 1968 through 2006 (Sauer et al. 2007). However, breeding bird survey data specific to Arizona and Forest-wide for the same years shows a slight increase, but this may not be fully reliable due to small a sample size.

Cordilleran Flycatcher

Cordilleran flycatchers breed primarily in pine, but also utilize spruce, fir and aspen forests. Cordilleran flycatchers prefer cool forested mountains and high-elevation plateaus. They breed from mid-May to September in Arizona. Nests are typically built in areas that provide a ledge and overhead cover. Nest sites include rock crevices or ledges, cave entrances, stream banks, and natural tree cavities. They are also known to nest among the root mass of upturned trees and on sections of peeling bark of logs lying over small drainages (Corman and Wise-Gervais 2005). Paine and Martin in their studies found that rock crevices, live aspen trees, and aspen snags provided 27, 23, and 12 percent of nest sites respectively along the Mogollon Rim (Latta et al. 1999). Breeding bird survey data from the Western Region shows a very slight downward population trend for this species from 1968 through 2006. The same data specific to Arizona shows a similar decline.

Purple Martin

Purple martins breed across the Mogollon Plateau region extending into Williams, Mount Trumbull, the Natanes Plateau, the Sierra Anchas, and the Prescott region in Arizona. The Kaibab National Forest has breeding residents on both the Tusayan and Williams Ranger Districts; however, their status is unknown on the Kaibab Plateau. Data from historical wildlife surveys on the Kaibab Plateau do not mention this species (Rasmussen 1941, Sharber et al. 1980). The purple martin requires cavities for nesting and forages for flying insects. Preferred habitats include open woodlands, forest meadows, open valleys, and areas near large bodies of water. Purple martins in Arizona prefer high snag-density areas adjacent to the open spaces of pine forests (Latta et al. 1999). Breeding bird survey data from the Western Region shows a positive population trend for this species from 1967 through 2006. The same data specific to Arizona shows a stable population trend for this species.

Direct and Indirect Effects for Migratory Birds

Alternative 1 – No Action

Under the no action alternative, forest conditions would continue to become denser. Herbaceous understory material is likely to decrease, with conifer encroachment impacting the quantity and diversity of insect forage for many migratory birds. The thick forest structure would continue to be susceptible to stand-replacing fires.

Alternatives 2 and 3

Mechanical and fire treatments from either of the action alternatives may result in unintentional take of birds, eggs, and nests; however, this would be mitigated by the existing seasonal restrictions and BMPs.

Effects on northern goshawks are addressed in the sensitive species section of this document. Proposed activities may directly affect this species temporarily through habitat modification or indirectly through changes in prey populations.

Disturbances to olive-sided flycatchers from thinning and burning would be short-term. This species has been linked to burned areas in ponderosa pine (Altman 1997, Blake 1982, Lowe et al. 1978 in Latta et al. 1999), and would likely experience short-term beneficial effects from the increase of post-burn insect abundance. Effects from vegetation modification and burning treatments would be beneficial, with the creation of more forest openings, more forest edges, and retention of large tree snags.

Disturbances to individual Cordilleran flycatchers from thinning and burning would also be short-term. Structure changes in project area vegetation would create more open habitat while reducing tree densities, which favors early-successional birds, not mid-to late-successional ones like the flycatcher. Additionally, known habitat for this species is in canyons, caves, and drainages where buffers required during project implementation would help protect this species.

Purple martins are associated with forests having open canopies, open mid- and under-story cover, and a high snag density. A lack of snags usually limits the abundance and distribution of this species. This does well following understory thinning and burning activities. Prescribed burning should provide a beneficial effect by temporarily increasing insect abundance. Implementation of either action alternative would provide varying degrees of suitable open canopy habitat for this species, even though these birds have not been documented on the District.

Executive Order 13186 also tasks federal agencies to identify unintentional take of migratory bird species during land management actions. The other potentially affected migratory birds have similar breeding and rearing periods; consequently direct and indirect impacts to these species are highly unlikely. Therefore, measurable negative effects on these bird populations are expected to be low to non-existent.

Kaibab Squirrel National Natural Landmark (NNL)

The Kaibab squirrel, a subspecies of Abert's squirrel, is endemic to the Kaibab Plateau and closely associated with ponderosa pine forests. The Kaibab Squirrel National Natural Landmark (KSNNL) was designated by the Secretary of Interior in 1965 and includes 278,459 acres of ponderosa pine forest within the Kaibab National Forest and Grand Canyon National Park. National Natural Landmarks (NNL) represents unique examples of ecological and geological features that make up our nation's natural history. The NNL designation does not withdraw lands from use nor does it dictate or prohibit any activity. National Natural Landmarks are managed under the National Park Service and require federal agencies to consider the unique properties of the NNL in their planning and impact analyses (Fed. Reg. 64:25718). Agencies with NNL designation need to provide opportunities that secure funding and partnerships capable of achieving management and conservation goals. The NNL was designated for the unique, geographically isolated Kaibab squirrel and as an example of the western climax community of ponderosa pine it inhabits.

The vegetation management efforts proposed in the Jacob-Ryan Project focus on returning the ponderosa pine forest to a short interval fire-adapted landscape that resembles pre-settlement conditions. The habitat needs for the Kaibab squirrel are similar to those identified in the northern goshawk guidelines and Kaibab Forest Plan desired conditions. Project design criteria (see Appendix H) require maintaining crown connectivity during tree stand structuring, because the Kaibab squirrel is highly dependant upon mature ponderosa pine with interlocking crowns. Squirrel numbers may decrease or be displaced temporarily during project implementation, but population numbers would continue to be greater than in presettlement time.

This project was discussed with the NNL Coordinator for the Intermountain Region. That person reviewed the status of the Kaibab squirrel, its habitat, current management, potential effects of wildfire on its habitat, and the proposed action. The NNL Coordinator anticipated little or no negative effects to the Kaibab squirrel or inconsistency with the NNL designation, and supports uneven-aged forest management as a means to maintain Kaibab squirrels and their habitat through time (PR 37).

Grand Canyon Game Preserve

The Jacob-Ryan project is located within the Grand Canyon National Game Preserve, which was established by proclamation by President Theodore Roosevelt on November 28, 1908 to protect game species and their habitat on the Kaibab Plateau. Section 1 of the Grand Canyon National Game Preserve Act states that "the reserve should be set aside for the protection of game animals and be recognized as a breeding place", and should be analyzed during any proposed land management activities. The only requirement of the Act is in section 2, to protect game animals from trespass. Specifically: "Hunting, trapping, killing, or capturing of game animals upon the lands of the United States within the limits of said areas shall be unlawful, except under such regulations as may be prescribed from time to time by the Secretary of Agriculture, which may not interfere with the operation of local game laws." The Kaibab Forest Plan was developed within this framework and incorporates the Grand Canyon National Game Preserve Act goals in Forest Plan direction.

The Forest Plan states: "Cooperate with the Arizona Game and Fish Department to achieve management goals and objectives specified in the Arizona Wildlife and Fisheries Comprehensive Plan, and in carrying out the cooperative agreement for the management of the Grand Canyon National Game Preserve." The Forest Service and Arizona Game and Fish Department agreed to allow hunting on lands managed by the District; the management activities in the Jacob-Ryan Project are designed to maintain huntable populations of game animals where possible and continue to provide breeding places for those species.

Effects to mountain lions

Current healthy and robust mountain lion population data are based on harvest information and observed lion sign. Yearly winter-harvest figures approximate a dozen lions. The migratory lion population of roughly 60 to 80 animals follows the deer herd as it migrates from summer to winter ranges. Impacts on mountain lions from the action alternatives directly correlate to impacts on the mule deer herd. Mule deer are likely to occupy more territory within the project area as openings are created and the understory forage increases. Implementation of the Jacob-Ryan Project should not impact the mountain lion as a game species.

Effects to other game species

Effects to game species have been considered as part of this assessment. Effects to Merriam's turkey, mule deer and the Kaibab squirrel have been addressed in the sections above. Jackrabbits, cotton tails, and coyotes may be temporarily displaced during prescribed burns, but should not be affected by mechanical thinning operations. Overall, game species will benefit from the effects of thinning and burning due to the resulting habitat heterogeneity. Increased grasses, forbs, and shrubs will provide increased foraging opportunities for herbivorous and omnivorous game species.

Conclusion

Both action alternatives would enhance game habitat overall and lower the risk of habitat-altering, high-intensity wildfire. Therefore, the proposed alternatives are consistent with the intent of the Grand Canyon National Game Preserve Act.

Cumulative Effects on Wildlife

Past activities have created a decrease in herbaceous forage, which is important for many of the northern goshawk prey species. Northern goshawk population fecundity and success is highly correlated to prey species availability (Reynolds, personal communication – PR63). Past timber management and fire suppression have reduced the quality of northern goshawk foraging habitat through out much of the project area. Current tree density and ladder fuels have reduced the openness of the understory where goshawks learn to fly and hunt. The goal of the Jacob-Ryan Project is to move toward the desired conditions using mechanical treatments to create open spaces and raise the base canopy heights for northern goshawk maneuverability in the understory. Overtime the project would encourage larger trees with interconnected crowns and the open areas would provide better foraging area for associated goshawk prey species identified in the Forest Plan.

Foreseeable future actions may include fuel reduction projects (thinning groups and prescribed burning). The effects of future vegetation management activities should cumulatively benefit northern goshawks and its prey, as well as management indicator and game species. This project would add nutrients to the soil, reduce competition of trees, and lead towards a more open under-story historically found in ponderosa pine stands. Forest Plan standards and guidelines for maintaining and/or providing large logs and coarse woody debris would help ensure sufficient decaying matter, which contributes to a healthier under-story and provides cover and micro-sites for grass and forb establishment.

Table 39 below provides a summary of the direct, indirect and cumulative effects to species from the proposed action and past, present, and foreseeable actions. Appendix E provides a summary of past, present, and foreseeable actions.

Table 39—Direct, indirect and cumulative effects on wildlife species for the project

Species	Direct and Indirect Effects of the Proposed Action	Effects of Past, Present, and Reasonably Foreseeable Actions	Cumulative Effects
Northern Goshawk	Short-term disturbances from project implementation.	Much of the landscape within the project area is a result of Forest Plan direction prior to 1996.	Creation of groups with adequate rooting zone spacing are likely to reduce the net cumulative effects
Bald Eagle	Short-term disturbances to wintering bald eagles that are foraging during project implementation.	These effects, combined with ADOT hazard tree removal for highways, have reduced the number of perch sites along winter foraging areas in the analysis area.	Cumulatively, these activities, combined with this project's activities, will not affect reproduction or the overall range of the bald eagle
Species	**Direct and Indirect Effects of the Proposed Action**	**Effects of Past, Present, and Reasonably Foreseeable Actions**	**Cumulative Effects**
Peregrine Falcon	Potential disturbance from smoke.	Short-term impacts from other projects in the area may disturb prey species and prey species habitat.	Cumulatively, activities do not affect the reproduction or overall distribution of peregrine falcons.

Spotted Bat	Short-term disturbances from project implementation.	Reduction of understory vegetation and insect forage availability from past activities.	Creation of openings may increase understory vegetation and insect forage, reducing the net cumulative effects.
Allen's Lappet-Browed Bat	Short-term disturbances from project implementation.	Reduction of understory vegetation and insect forage availability from past activities.	Creation of opening may increase understory vegetation and insect forage, reducing the net cumulative effects.
Pale Townsend's Big-eared Bat	Short-term disturbances from project implementation.	Reduction of understory vegetation and insect forage availability from past activities.	Creation of opening may increase understory vegetation and insect forage, reducing the net cumulative effects.
Mountain Lion	Short-term disturbances during project implementation.	Previous short-term disturbance during implementation.	Cumulatively, activities do not affect the reproduction or overall distribution of mountain lions.
Kaibab Least Chipmunk	Short-term disturbances from project implementation. Potential loss of down woody debris from proposed fuel treatments.	Warm Fire removed more downed woody debris than the Forest Plan recommends (5-7 tons of downed woody debris per acre).	There is no effect to Forest-wide habitat or population trends; therefore, there is no additive effect to past, present, or foreseeable projects.
Kaibab Squirrel	Short-term disturbances during project implementation, long term benefits associated with creating groups of interlocking crowns.	Previous projects created areas lacking in higher basal areas that provide high-quality nesting habitat.	There will be no cumulative effects to Forest-wide habitat or population trends.
Kaibab Northern Pocket Gopher	Short-term disturbances from project implementation, long term benefits associated with creation of openings, hence increasing herbaceous forage material.	Reduction of understory vegetation/forage availability from past activities.	There is no effect to Forest-wide habitat or population trends; therefore, there is no added effect to past, present, or foreseeable projects.
Pygmy Nuthatch	Short-term disturbances from project implementation, direct impacts from proposed fuel treatments may cause a loss of snags in analysis area.	ADOT hazard tree removal for highways may have reduced the number of snags in the analysis area.	Previous projects combined with the proposed project are not expected to reduce habitat quality enough to alter Forest-wide population or habitat trend.
Olive-sided Flycatchers, Cordilleran flycatchers, Purple Martins.	Short-term disturbances from project implementation.	Reduction of understory vegetation and insect forage availability from past activities.	Creation of openings may increase understory vegetation and insect forage, reducing the net cumulative effects.
Hairy Woodpecker	Direct impacts from proposed fuel treatments may cause a loss of snags in analysis area.	ADOT hazard tree removal for highways may have reduced the number of snags in the analysis area.	Previous projects combined with the proposed project are not expected to reduce habitat quality enough to alter Forest-wide population or habitat trend.

Heritage Resources

Affected Environment

Human occupation on the North Kaibab Ranger District (NKRD) dates to the Paleo-Indian period (11,000-9,000 years ago). Physical evidence indicates that human use occurred throughout all the environmental zones on the District. The last native peoples to settle in the area were the Southern Paiutes. The Paiutes were hunter-gatherers whose lifestyle, language, and material culture suggest they migrated from the Great Basin area. They were a highly mobile people who utilized most of the District for big and small game, pinion nuts, plants, and lithic resources.

The first documented visitation to the area by Europeans was in 1776 by Spanish priests Dominquez and Escalante, but actual settlement occurred during the 1850s with the arrival of Mormon settlers. The North Kaibab Ranger District was heavily grazed by sheep and cattle during the open range era of the late nineteenth century. Grazing stock numbers were substantially reduced following the establishment of the Kaibab National Forest in 1908. Limited prospecting and mining occurred in the Jacob-Ryan vicinity during the late nineteenth and early twentieth centuries. Copper was the primary mineral extracted from mining operations; however, most of the Kaibab Plateau was withdrawn from mineral entry following the establishment of the Grand Canyon National Game Preserve. Logging played a more important role on the Plateau than mining. Early logging consisted of small scale horse-logging in drainages near springs that could support steam powered saw-mills. Logging intensified and became an important industry on the District with the establishment of a road system and truck transport.

Many heritage resource inventories have been conducted within the Jacob-Ryan project area over the past four decades. The majority of inventories have been small-scale in response to fuels reduction projects, timber sales, special uses permits, administrative site maintenance, and road and trail installations. Large-scale block surveys include Jacob-Ryan Northwest Phase 1 (Reid and Morgan 1999), Jacob-Ryan Phase II (Haynal and Reid 2002) and Jack Fuels (Reid and Haynal 2002). Additional surveys within the project area and other adjacent surveys indicate a medium site density within the ponderosa pine zone and higher site densities in the pinyon/juniper transition zone (Nicholas and Betenson 2007; Betenson 2007; Reid and Hanson 2006; Snyder 2005; Haynal and Reid 2002; Reid 2001 and 2000). The project area was surveyed and inventoried for heritage resources and sites using the guidelines specified for the North Kaibab Ranger District (Reid and Hanson 2006).

Approximately 24,000 acres of the project area were previously surveyed in association with past projects. An additional 1,255 acres were surveyed for this project in May, 2008 (Reid 2008). One hundred thirty-five sites are documented within or adjacent to proposed Jacob-Ryan treatment units. Both the Kaibab Paiute and Hopi tribes claim cultural affiliation with prehistoric sites located on the District. Documented prehistoric sites include camps and rock shelters comprised of artifact scatters and pueblo habitation sites. Historic sites are more commonly associated with logging, mining, Forest Service administration, fire management operations, livestock grazing, and Native American pinyon gathering. Site types include log cabins; can/bottle refuse scatters, lumber mill sites, mining trenches and pits, livestock corrals, dendroglyphs, fire lookout trees, and a fire lookout.

Several Navajo families worked at the Orderville Canyon lumber mill during the mid-twentieth century and built small hogans in a wooded area near the mill operation. A Navajo brush structure and several collapsed hogans are located at a historic lumber mill site. Some Navajo use also occurred during the twentieth century, primarily tied to pinion nut and fuel wood collection.

Laws, Regulations, and Policy

Federal land managers are responsible for the protection and enhancement of significant heritage resources under 36 CRF 800, as per sections 106 and 110 of the National Historic Preservation Act (NHPA), as amended. These include both physical manifestations of past human activities and specific locations that are traditionally important to interested tribes. Federal agencies are charged with avoiding or minimizing impacts to significant archeological and historical sites, as well as to traditional cultural properties. Therefore, locations and condition of existing heritage resources are identified and documented prior to implementing any Federal undertaking. Significant resources are protected primarily through site avoidance. Other protective measures have come about with the development of various design criteria established by the agency in consultation with the State Historic Preservation Office (SHPO) and the Advisory Council on Historic Places (ACHP).

The National Heritage Preservation Act and the American Indian Religious Freedom Act, along with various other laws and regulations, require that agencies consult with culturally affiliated tribes to determine the effects of the project on sites and areas culturally significant to the tribes. The Kaibab National Forest consulted with the Kaibab Band of the Southern Paiute Indians (January 28, 2008) and the Hopi Tribe (February 20, 2008) to identify traditional properties and resources of concern. The Navajo Agency of the Navajo Nation was consulted on February 14, with a follow up on May 22, 2008. All tribes supported the project and the implementation of standard site avoidance measures. No other issues were raised.

Direct and Indirect Effects by Alternative

Alternative 1 – No Action

The no-action alternative would not alter the existing condition and have no direct effect on heritage resources. However, existing fuel loading and the high risk of a stand-replacing wildfire could have an indirect effect on heritage sites. A wildfire could cause severe damage to heritage resource sites. The resulting losses of historical value would require additional field inventories and consultation with the State Historic Preservation Office.

Alternative 2 – Proposed Action

The activities associated with treatments listed in Alternative 2 (the proposed action) have the potential to directly impact heritage resource sites. Many of the techniques utilized during vegetation management, timber salvage, reforestation, and fuels treatments are associated with ground disturbing activities. All heritage resource sites have been identified and documented in order to protect the sites, using standard cultural resource surveys outlined in the North Kaibab Survey Strategy (Reid and Hanson 2006). The sites would be flagged for avoidance prior to project implementation. Standard survey procedures are designed to identify and document sites visible on the surface of the ground. Activities would cease during project implementation in the event that an undocumented site is unearthed. The North Zone archaeologist would be contacted to assess the site and complete any required heritage consultation.

All unevaluated heritage sites or sites eligible to the National Register of Historic Places would be avoided during project implementation. Prescribed burning would be permitted at non-fire-sensitive sites. The piling of slash, pile burning or broadcast burning of slash would not be authorized on top of known sites. These design criteria would meet site protection standards in accordance with the provisions in the Programmatic Agreement for Compliance with Section 106 of the National Historic Preservation Act for Undertakings in Region 3, USDA Forest Service. Alternative 2 should have no direct or indirect adverse effects to heritage resource sites during project implementation with the use of the above design criteria.

Alternative 3

The activities associated with treatments listed in Alternative 3 would be the same as those listed under Alternative 2 except that no trees greater than 12 inches DBH would be removed. Identification and protection of heritage resources would be the same as in Alternative 2. If the above design criteria are met and implemented, the activities proposed by this alternative should have no direct or indirect adverse effects to heritage resources or sites.

Cumulative Effects

The cumulative effects analysis area is the project area. All treatment areas within the Jacob-Ryan planning area have been systematically surveyed for cultural resources. Effects are usually confined to sites identified during project surveys because heritage sites are stationary. Cultural and heritage sites found and located during the proposed activities would also be protected by the above-mentioned standard design criteria. There would be no cumulative effects to heritage resources from the no-action Alternative because no ground disturbing activities or prescribed burning would occur in the project area. The State Historic Preservation Office concurs with the District archeologist regarding the lack of potential effects with the use of protective measures (PR 55). Consultation with local American Indian tribes was conducted to identify any areas of cultural sensitivity within the planning area. No issues or concerns were identified.

Implementation of project activities would be in accordance with 36 CRF 800 and the programmatic agreements governing historic preservation requirements for Forest Service undertakings. The North Zone archaeologist would coordinate and help develop plans for heritage resource protection measures when implementing any action alternative. The required use of design criteria during project implementation should minimize potential impacts on heritage resource sites within the project area. Adherence to the above stipulations would ensure that the project is in compliance with Section 106 of the National Preservation Act and that there would be no adverse effects to heritage sites from project implementation. Because the action alternatives would not have adverse direct or indirect effects, there would be no adverse cumulative effects.

Alternative Comparison for Heritage Resources

Table 40—Effects for each alternative on heritage resources

Alternative 1	Alternative 2	Alternative 3
No direct effects Possible indirect effects: existing fuel loading in the event of a stand-replacing wildfire could damage heritage sites.	No direct or indirect adverse effects	No direct or indirect adverse effects

Range Resources

Affected Environment

The project area occurs within parts of the Ryan and Central-Summer grazing allotments (see Figure 15). About 85 percent of the project falls inside the Ryan allotment that consists of three summer pastures, two winter pastures and three small holding pastures. The pastures are all on a deferred rotation of use.

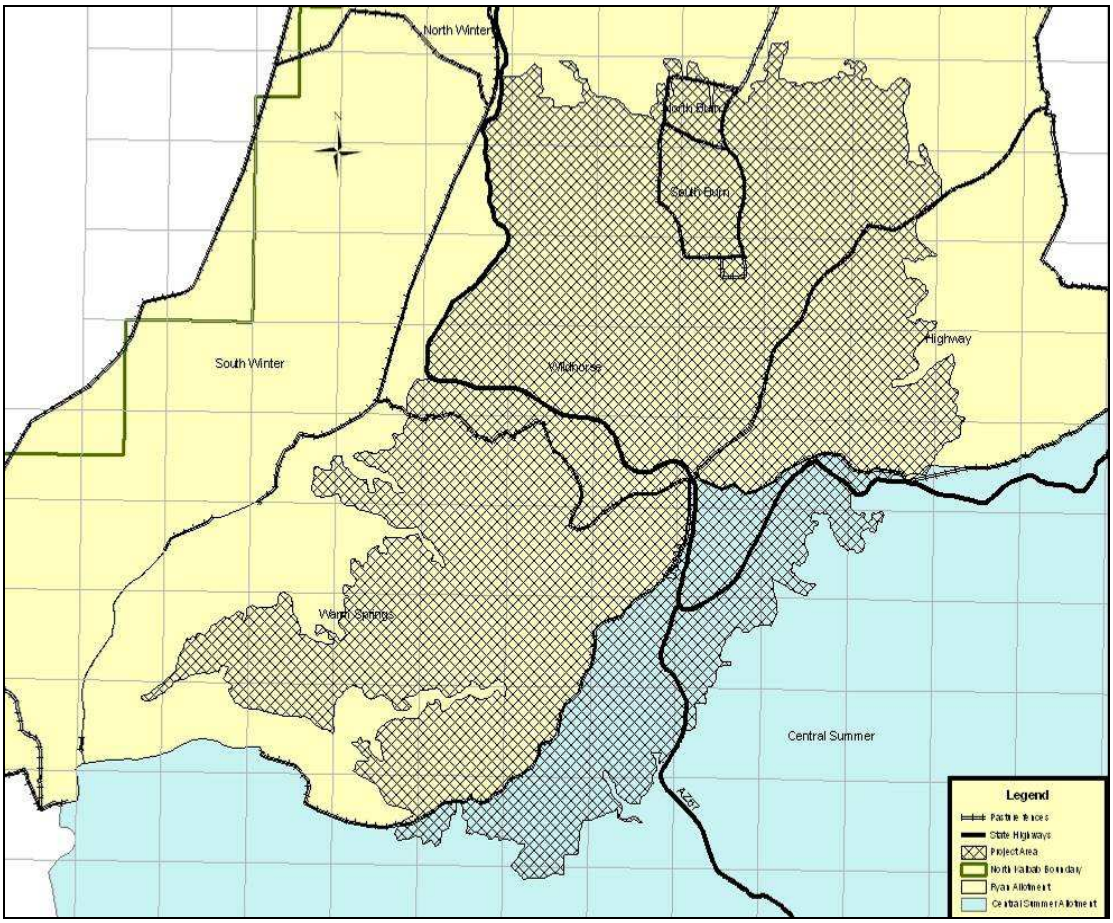

Figure 16—Grazing allotments in relation to the project area

The 2006 range analysis describes the allotment vegetation trend along with watershed condition as substantially improving from the previous 1986 analysis and in some instances already achieving proper functioning condition (which is the desired condition for range lands). The range improvements can be attributed too conscientious monitoring, reductions in livestock use, improved management practices, and an aggressive weed management and eradication program. Although vegetation and watershed conditions are improving, the capability of the land for livestock grazing is decreasing, primarily from conifer encroachment and timber stand densities.

The increased competition for space, nutrients, light, and moisture restricts non-woody understory recruitment. The ability of a site to hold soil and moisture decreases when non-woody understory vegetation decreases and is replaced with large amounts of conifer needle-cast. As a direct result of monitoring and adaptive range management in the last 20 years, the pastures in the Jacob-Ryan project area have shifted to a higher range and soil stability condition in spite of drought conditions over half the same time period. However, grazing capabilities could deteriorate further over time unless conifer encroachment and stand densities are reduced.

Direct and Indirect Effects by Alternative

Alternative 1 – No Action

Current management and conditions are expected to continue in the short term under the no-action alternative. Vegetative under-story conditions inside the project area would continue to decrease incrementally, especially in a 5- or 10-year timeframe. Grass, forbs, and shrubs would diminish as

they are out-competed by increasing stand densities and suppressed by heavy pine needle litter. Grazing management would remain the same until such time as the percentage of forage utilization is unacceptable, thereby making it necessary to either reduce animal allotment numbers or the timeframe of pasture use.

Alternatives 2 – Proposed Action

The proposed action would thin conifers and reduce stand densities, which would reduce the competition for space, light, moisture, and nutrients for both conifers and understory vegetation. The prescribed burning treatment would add nutrients to the soil while reducing the heavy litter layer to an acceptable level. Noticeable improvements would be visible within a year following any treatment. Forage production would be influenced by site-specific factors, including type and intensity of vegetation treatment, soil type, slope, and moisture.

Provided there is adequate annual moisture following treatments, it is expected that the average understory plant production would increase by at least 50 percent. The available forage for both livestock and wildlife would increase; therefore, lower utilization rates can be expected for the same number of animals using the range.

Coordination between livestock operations and the implementation of vegetation treatments would help offset potential adverse effects to the success of the treatments. Normal mechanical-thinning operations should not affect livestock range use or distribution. Intensive activities like prescribed burning would occur in only one pasture at a time. The livestock permittee should be able to graze full permitted numbers on the remaining pastures in the allotment. The treated pastures would then be rested from grazing for two growing seasons unless monitoring determines that additional grazing deferment is needed. Resting the pastures following burn treatments allows understory vegetation to become re-established and provides an opportunity to monitor and treat for invasive plant species before grazing resumes. Monitoring of the active and rested pastures ensures that excessive utilization does not occur during planned year-to-year pasture rotations.

Only prescribed burning has the potential to affect future grazing strategies on the Ryan Allotment. The Central-Summer allotment should not be affected, as that portion of the allotment is in and around Forest Service administrative areas of Jacob Lake and the scenic byways where livestock use is discouraged.

Alternative 3 – Twelve-Inch Diameter Limit

The effects on grazing and grazing resources are expected to be very similar to those of the proposed action, with the exception that understory gains would likely be lower due to fewer trees being removed.

Cumulative Effects

The cumulative effects analysis area is the project area. Only beneficial effects are anticipated from the action alternatives. The cumulative effect of the either of the action alternatives when added to past present and future projects would be a contribution toward improved range condition and trend in the analysis area.

Non-Native Invasive Plants

Affected Environment

Non-native invasive species continue to pose a threat to public lands. These plant species can rapidly alter landscape composition by displacing native species. Disturbed areas from management activities provide the open soil necessary to give invasive species the opportunity to

become established and thrive. Land managers need to forecast and plan for the spread of invasive weed species and incorporate weed prevention and control measures into project design criteria.

There are several species of invasive weeds that have been found on the North Kaibab Ranger District (see Table 26). Musk thistle, spotted knapweed, and cheat-grass all occur inside the project area along State Highways 89A and 67. Once species like thistles and knapweeds become established, it takes years to eradicate the population. Manual hand grubbing of the thistle and knapweed populations has been ongoing since 2003 and is proving to be an effective method of control.

The primary invasive species of concern is cheat-grass (*Bromus tectorum*), an annual grass species that germinates in the winter or spring. Large cheat-grass plants can produce about 400 seeds (Zouhar 2003) and the type of seed it produces makes it easily transported on clothing, animals, and vehicles. This species is very successful at growing in periods of drought and in poor soil conditions. The ability of cheat-grass to produce large amounts seed before other species enables it to out-compete and rapidly take over a site. Most of the larger cheat-grass populations are found in disturbed pinion/juniper woodlands, but some populations have been located within the ponderosa pine community type and along several roads in the project area.

Forestwide, cheat-grass poses the greatest risk of having a negative effect to the project area. Forest Service surveys in conjunction with a cheatgrass occurrence prediction model produced by Northern Arizona University and the Grand Canyon Trust have helped identify potential problem areas that can be effectively treated before they spread out of control. Other invasive species occur primarily outside the project area, but still pose a threat of being transported into the area. The control and eradication of non-native invasive plant species is an integral program on the North Kaibab Ranger District. Over time, current known thistle and knapweed populations in the project area will be reduced and/or eradicated. Monitoring is ongoing to locate and eradicate invasive plant populations on the Forest. Table 41 below lists the known non-native invasive plant species on the Kaibab Plateau in relation to the Jacob-Ryan project area.

Table 41—Known non-native invasive plant species in relation to the project area

Non-Native Species	Population Locations
Musk Thistle *(Carduus nutans*)	Several small populations inside the project area around Jacob Lake and along State Highway 89A.
Spotted Knapweed *(Centaurea masculosa)*	Small populations in numerous places along State Highway 67, including the project area.
Scotch Thistle *(Onopordum acanthium)*	Five populations on western side of NKRD. Nearest population is 12 miles from the project area.
Canadian Thistle *(Cirsium arvense)*	Several populations along State Highway 89A eight miles from project area.
Leafy Spurge *(Euphorbia esula)*	One population near Big Springs on NKRD, 10 miles from project area.
Cheatgrass *(Bromus tectorum)*	Numerous populations across NKRD, including the project area. Large populations currently exist in the vicinity of the 1996 Bridger Knoll Fire.
Diffuse Knapweed *(Centaurea diffusa)*	An isolated population near DeMotte Park, 20 miles from the project area.
Bull Thistle *(Cirsuim vulgare)*	No known populations on NKRD, but the species can be found on federal lands in Northern Arizona.
Yellow Starthistle *(Centaurea solstitialis)*	No known populations on NKRD, but the species can be found on federal lands in Northern Arizona.

Direct and Indirect Effects by Alternative

Alternative 1 – No Action

Under the no-action alternative, invasive species would continue to be introduced and spread at the current rate by animals, wind and human activity. The project area would experience a lower level of monitoring because no management activities are proposed. The no-action alternative perpetuates the high risk of a stand-replacing wildfire that could create suitable introduction sites. Crawford et al. (2001) reported higher cover of cheat-grass on severely burned sites compared to less severely burned sites. Comparable results on this Ranger District have been documented following the Bridger Knoll Fire (1996).

Effects Common to the Action Alternatives

There would be increased ground disturbance with any of the action alternatives. This could spread existing infestations and introduce new ones. The degree of local disturbance by vehicles and heavy equipment during tree removal is the main variable contributing to invasive species introduction. Pre-project monitoring and treatment for invasive weed species along with the use of best management practices (see Appendix H) to prevent, detect and control those species during project implementation would greatly minimize their spread. The one-year waiting period between mechanical thinning and prescribed burning also provides an additional opportunity to monitor the disturbed areas for invasive species and eradicate them before they get established.

The potential risk of non-native invasive species transmission and establishment could continue at current rates or possibly higher. The potential for invasive plant species to replace native grasses, forbs, and shrubs is the greatest direct effect of both action alternatives. Invasive species proliferation indirectly reduces the amount of capable acres available for livestock grazing and forage for wildlife. These invasions also increase the amount of time necessary for monitoring and costs for control and eradication. However, potential infestations should not prohibit vegetation management programs. Proper planning, monitoring, and best management practices can contribute to successful management projects.

Comparison of Alternatives 2 and 3

The proposed action (Alternative 2) proposes to remove more trees than Alternative 3, which would result in more activity and more ground disturbance. However, the proposed action would also be less likely to support a high-intensity wildfire which is associated with weed spread and establishment.

Cumulative Effects

The cumulative effects analysis area is the project area. The primary activities that contribute or have contributed to the spread and establishment of weeds in the project area are associated with the roads. Most of the current infestations are near main roads. Recreation activities and livestock grazing in the project area can also contribute to the establishment of weeds by serving as vectors and disturbance agents. The District weed program monitors and treats weeds annually.

The action alternatives may contribute to weed transport and establishment, but weed monitoring and treatment before, during, and after project implementation (as per the BMPs), along with other weed best management practices, would prevent adverse effects. Because there would be no direct or indirect adverse effects, the proposed action would not contribute towards an adverse cumulative effect when added to other past, present, and foreseeable actions in the project area.

Rare Plants

Affected Environment

The Jacob-Ryan Vegetation Management Project is being reviewed for possible effects on endangered, threatened, or sensitive plant species. The following sources were referenced to determine the list of species to be analyzed:

- NKRD GIS sensitive plant database
- US Fish and Wildlife Service website (http://arizonaes.fws.gov)
- 2006 Ryan, Suicide, Houserock Allotment Management Plan revisions
- Ongoing Warm Fire Recovery DEIS

Two plant species of concern were found to be potentially affected by the proposed action. The first is the Paradine plains cactus, a Forest Service sensitive species, which is currently managed under a Conservation Agreement between the U.S. Fish and Wildlife Service, the Forest Service, and the Bureau of Land Management (USDI, Fish and Wildlife Service et al. 1998). This singly small, green, round-looking cactus is usually no more 1.5 inches tall above ground with half of its stem underground. During periods of drought, individual plants retract into the soil and are covered with soil and pebbles (Phillips et al. 1996). The Paradine plains cactus is known to occur exclusively on the eastern slopes of the Kaibab Plateau and in Houserock Valley. The habitat normally consists of pinyon/juniper or shrub/grassland of valley bottoms or on ridge tops. The closest suitable habitat and location for this species is in Trail Canyon, about a mile outside the eastern project boundary.

The second species is the Fickeisen pincushion cactus, a small solitary or clustered round-looking cactus with corky spines. Like the Paradine plains cactus, it also retracts into the soil during periods of drought. The Fickeisen cactus has been placed on the federal threatened and endangered plant candidate list. This species is known to occur in multiple locations across northern Arizona. It inhabits flat ridge tops in cold desert shrub communities favoring gravelly limestone soils. The suitable habitat for the species falls entirely outside of the project area. The

closest suitable known habitat and location for this species occurs near Snake Gulch, about 8 miles outside the southwestern edge of the project boundary.

Direct and Indirect Effects by Alternative

Alternative 1 – No Action

There are no direct effects to either species expected from the no-action alternative, as there would be no ground-disturbing activities or prescribed burning. A high-intensity wildfire could affect both species indirectly if the fire got out of the project area. A fire could create openings in the canopy cover, reducing competition and making moisture and nutrients more available to understory species (including cacti). Alternately, a fire could destroy upland ground vegetation, making it susceptible to erosion during precipitation events, such as what occurred in Trail Canyon following the Warm Fire.

Alternatives 2 and 3

No direct effects are expected from these alternatives, as all known habitat and species locations are well outside the project boundaries. Continued monitoring and treatment of invasive non-native species, especially cheat-grass, would be implemented under either alternative.

Cumulative Effects

Because there would be no direct or indirect effect of the action alternatives on these plant species, there would be no cumulative effects. These species occur well outside project area boundaries and in completely different vegetation types.

Visuals and Recreation

Affected Environment

Visual or scenic resources and recreation resources are two elements within the social realm of public land management. The two are related, as high-quality scenery is often very important for high-quality recreation activities. This assumption is the basis for the recreation opportunity spectrum: Recreationists choose certain forest settings to engage in their recreation pursuits (USDA Forest Service 1986). Scenic beauty and availability of recreation opportunities are also critical to the tourism industry. Much of the local economy and many local businesses depend on tourism. The five-county area of southern Utah, which includes Kane County (Kanab, UT), leads the State in tourism-related visitation, with over eight million people visiting it each year (State of Utah 2003). Visitation to the North Rim of Grand Canyon National Park averages about 300,000 people per year. The scenic beauty of the Kaibab Plateau is also important to the growing Fredonia-Kanab area residents' quality of life, as well as to the sense of place of long-time residents.

The amended Kaibab National Forest Land Management Plan (USDA Forest Service 2004) applies the Visual Management System and its associated Visual Quality Objectives to sensitive areas and road or highway corridors on the North Kaibab Ranger District. Scenic integrity, a concept incorporated from the Scenery Management System (USDA Forest Service 2000) used on the south zone of the Forest, is helpful in describing effects of proposed actions. Scenic integrity is a measure of the extent the landscape appears to have the significant scenic elements described in the landscape character descriptions. Scenic integrity can be applied to different scales. For this document, the project scale applies mainly to short-term effects; the landscape scale is used for long-term and cumulative effects analysis.

The Visual Management System (USDA Forest Service 1989) describes the landscape of the North Kaibab Ranger District as falling into the Grand Canyon Character Type, Plateaus Subtype. The Ranger District is north of the Grand Canyon and characterized by broad flat plateaus that stair step up from west to east. The Kaibab Plateau is the highest and most beautiful plateau, attaining an elevation of over 9,000 feet. This plateau is an uplift block whose surface is maturely dissected by rounded valleys of gentle slope. Sagebrush, plains grassland, and pinyon/juniper woodland dominate the plateaus. The Kaibab also has coniferous forests, which are about half montane conifer and half sub-alpine conifer.

The characteristic landscape is made up of the physical characteristics of rock form and water, the biological characteristics of the vegetation type and habitat, and cultural features. Since this project will not affect the rock or water features, and the cultural features are excluded except for dispersed recreation activities, this report will concentrate on changes in vegetation. The vegetation in the Jacob-Ryan project area is primarily ponderosa pine. The current forest condition within the project area is outside of the range of historic variability and is susceptible to stand-replacing wildfire and insect and disease outbreaks. Forest health has been compromised by changes in stand density, lack of tree-size diversity, increased ladder fuel and the spread of dwarf-mistletoe. The scenic integrity of the Jacob-Ryan project area is moderate to low, depending upon the viewer's location. Noticeable deviations must be visually subordinate to the landscape character.

The desired condition is to move toward the characteristic landscape for vegetation. The ponderosa pine forest would be (and appear) more open; stands would have more groups of trees with spaces between them. Overall tree density would be reduced and would move toward pre-settlement conditions (the desired landscape characteristic). Grass, forb, and shrub growth would increase and provide better visual diversity due to more open conditions and open areas. Older trees would again be a visible and dominant component of the area. Uneven-aged groups of trees would be found throughout the area. It would be possible to see through the forest because of more open conditions. A synthesis of research about aesthetics and fuels management provides four common visually preferred settings: (1) large trees, (2) herbaceous, smooth groundcover, (3) open mid-story canopy with high visual penetration, and (4) vistas with distant views and high topographic relief (McCool 2007). The first three landscape settings concur with the goals for the characteristic landscape and can be influenced by management actions, while the last setting (vistas and high topographic relief) occur naturally.

Visual Management System

The visual quality objectives (VQO) which are part of the Forest Service visual management system (USDA Forest Service 1974) and included in this project are the following:

- Retention: Management activities which are not visually evident. Landscape changes in their qualities of size, amount, intensity, direction, pattern, and others should not be evident. Remediation in Retention zones should be accomplished either during an operation activity or immediately afterward.
- Partial Retention: Management activities remain visually subordinate to the characteristic landscape. Remediation to meet the requirements of Partial Retention should be accomplished as soon after project completion as possible or, at a minimum, within the first year.
- Modification: Management activities may visually dominate the original characteristic landscape. Activities should borrow from the natural landscape in form, line, color, and

texture to mimic natural occurrences. Parts of these activities such as structures, roads, slash, and others must remain visually subordinate to the proposed composition. Remediation should be accomplished in the first year or, at a minimum, should meet existing Regional guidelines.

These objectives provide guidance for conducting resource operations or improvements. Deviation from these guidelines does not require a Forest Plan amendment, but departures must be addressed in the appropriate decision document. Improvement of the scenic integrity can be achieved by decreasing the visual contrast of the deviations from the characteristic landscape.

Recreation Opportunity Spectrum (ROS)

The Recreation Opportunity Spectrum (ROS) is a framework used by the Forest Service for defining classes of outdoor recreation opportunities. The settings, activities and opportunities for recreation experiences have been divided into six classes: primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural, rural, and urban. Opportunities for experiences along the spectrum represent a range from very high probability of solitude, self-reliance, challenge, and risk, to a very social experience where self-reliance, challenge, and risk are relatively unimportant. Not all classes of activity would necessarily occur on every forest. The Kaibab National Forest has very few urban settings, but does have some areas in the other classes. The project area is assigned ROS categories of roaded natural, semi-primitive, semi-primitive non-motorized, and semi-primitive motorized, as per the July 1986 Forest Plan maps (USDA Forest Service 2008). For simplicity, the Jacob-Ryan project area is essentially a rural setting with areas of "roaded natural" and "roaded modified."

Within the project boundary, but not part in the treatment area, are several recreation developments, facilities, and administration sites. The Jacob-Ryan project area is used for dispersed camping, hunting, hiking, horseback riding, off-highway vehicle driving, forest product gathering, and other activities. Although these activities are generally less concentrated in their impacts or numbers of people in one area, the expectation for a quality recreation experience is still high. Often dispersed users are more sensitive to vegetation alterations than users who are mainly viewing scenery from their vehicles.

Direct and Indirect Effects for Visual Quality and Recreation

Alternative 1 – No Action

The landscape in the no-action alternative would experience slow changes overtime. Changes in scenery would result from natural disturbance rather than planned activities. The forest would continue to have tree densities many times greater than historic conditions. Likewise, visitors would experience a lack of visual diversity, monotony, and a tunnel-like perception of the dense forest while driving on roads through much of the project area. The scenic integrity would continue to be broken up, with abrupt changes due to past management practices (e.g., old seed-tree cuts adjacent to dense, un-thinned stands of young trees). The potential for large-scale natural disturbances such as wildfire and insect infestation would remain high and increase over time. While these are natural occurrences, stand-replacing fires and the resulting erosion processes or large-scale tree mortality from insects would generally be considered uncharacteristic for the forest and would be visually unappealing to visitors, permittees, and businesses. The landscape would recover over time, and the visual quality would improve as well, but this timeline could be over several human generations.

The current recreation opportunities and the quality of the experiences would remain the same unless a large-scale event (wildfire or insect-induced tree mortality) occurs. If such an event occurs, the recreation opportunities would change drastically and in a negative direction for the foreseeable future. In the event of a wildfire, there is a possibility that the adjacent facility investments at and near Jacob Lake would be burned as well.

Alternative 2 – Proposed Action

Under Alternative 2 (the proposed action), the Jacob-Ryan Vegetation Management Project would result in improved scenic quality over time. The ponderosa pine forest would be (and appear) more open; stands would have more groups of trees with spaces between them. Overall tree density would be reduced and would move toward pre-settlement conditions (the desired landscape characteristic); grass, forb, and shrub growth would increase due to more open conditions and open areas. Older trees would again be a visible and dominant component of the area. Uneven-aged groups of trees would be found throughout the area. Treated areas would be less vulnerable to crown fires, and the reintroduction of fire would help to maintain forest health, making the area less vulnerable to wildfire and insect infestations. There may be some negative, short- to long-term public perception of burned areas due to the burned bark on some trees, small tree mortality, and blackened ground (McCool 2007).

From the design criteria (see Appendix H), slash treatment concurrent with vegetation removal would meet Retention and Partial Retention requirements (slash treatment would include activities such as piling or chipping, and does not include burning). Slash disposal (burning) would probably not meet the Retention VQO because the slash must cure enough to have good consumption of the fuels when burned. This typically takes six months or longer after piling, and this timeframe would not meet the requirements of Retention during operation or immediately after. Slash disposal only meets Partial Retention if burning occurs within a year after treatment. Once slash pile burning is completed, the areas would begin to meet the VQO.

Another exception to meeting the VQO is the rehabilitation work on skid trails, log decks, and other areas disturbed during vegetation treatment and slash burning. The rehabilitation work is typically completed after the vegetation treatment is completed; this would not be consecutive or immediately afterward for Retention areas. It is unknown if these would meet the Partial Retention needs of rehabilitation within one year. As soon as the rehabilitation work is completed, these areas would begin to meet Retention and Partial Retention.

Management-ignited fire (broadcast burning) would generally occur after the vegetation management activities are completed. Burning is often scheduled for the fall, and evidence of this activity is substantially reduced by the following spring or summer when grass, forb, and shrub growth begins and the trees have the first needle cast. Management-ignited fire would not meet the guideline of Retention during operation or immediately after, as the evidence of management activity remains until the next growing season. The area would meet Retention guidelines in the next growing season. Partial Retention areas may have the same exceptions, depending upon how quickly slash is burned and management-ignited fire proceeds. Management-ignited fire will meet Partial Retention during the next growing season. In areas of modification VQO, the area should appear visually compatible as soon as possible, or within one to two years after slash treatment and disposal is completed.

Short-term effects of timber harvesting, thinning, slash treatments, and managed fire would be apparent during the management activities and would diminish over time. These activities would lower visual quality and may be considered unpleasant to forest users. It is acknowledged that weather and other unforeseen conditions can alter the vegetation and slash treatment schedules,

causing delays in meeting the visual quality objectives. This being said, Alternatives 2 and 3 meet the Forest Plan guidelines or state the deviations from the ROS/SMS guidelines that are expected.

The fact that many public viewers generally consider the existing condition desirable should not be seen as an endorsement of the present condition, but may be an indication of people being comfortable with the familiar. Daniels (2003) examined human reactions to wildfire hazard and acknowledged that, in order to protect against an uncertain threat in the future, fuels treatments require immediate public acceptance for changes in their environment. In addition, there is also an assumption that cutting the forest would produce a less aesthetic, less "natural" landscape; often incremental change is more acceptable than drastic change. Initial reactions to trees being harvested and thinned, ground disturbed, and a forest floor freshly burned will often be negative. Over time as these changes diminish, burned areas "green up", and the disturbed soil stabilizes, the reactions begin to be more positive. Overall, the scenic effects of the proposal would result in temporary lowering of the visual quality, but with time increase in visual quality is anticipated as the proposed management activities are concluded. The proposed activities should also bring the scenic integrity to a higher level where the valued landscape character is more apparent and appears only slightly altered. Noticeable deviations would be lessened and progress would be made toward the desired condition.

There would be a short-term decrease in recreation opportunities because of the vegetation management activities. Some hunters might be displaced, dispersed campers might not be able to use their favorite camping spot, or hikers may be restricted to established trails or may be asked to stay out of areas where trees are being felled, equipment is being used, or management-ignited fire is being used. Forest visitors taking scenic drives and off-highway vehicle users would still be able to use existing open roads, but they may encounter some roads that are temporarily closed to public use in the Jacob-Ryan area.

Alternative 3 – Twelve-Inch Diameter Limit

Under Alternative 3, using the proposed design criteria, the project area would result in a lesser improved scenic quality over time. Timber stands would retain high numbers of large diameter trees, but many areas would continue to look like even-aged stands of trees over 12 inches DBH. Overall tree density would be reduced and there would be some movement toward presettlement conditions. Grass, forb, and shrub growth would increase somewhat due to the thinning. Old-growth areas and areas with trees over 12 inches DBH would not receive necessary vegetation management and would still remain vulnerable to wildfires, disease, and insect infestations.

Vegetation treatments and slash treatments would have similar effects as stated for Alternative 2, although there could be more charred and scorched trees and possibly greater tree mortality with fewer trees removed. Therefore, visual results may be more noticeable and considered unpleasant to forest users. This alternative would need to meet the same general timeframe for meeting the VQO as stated in Alternative 2. Overall, the scenic effects for Alternative 3 would result in the temporary lowering of visual quality. The proposed activities would improve the scenic integrity, but the valued landscape character would appear only slightly altered over time when compared with Alternative 2. Progress would be made toward the desired condition for scenic integrity, but at a much slower pace, and would not be as effective.

There would be a short-term decrease in recreation opportunities because of the vegetation management activities. Some hunters might be displaced, dispersed campers might not be able to use their favorite camping spot, or hikers may be restricted to established trails or may be asked to stay out of areas where trees are being felled, equipment is in use, or management-ignited fire is being used. Forest visitors taking scenic drives and off-highway vehicle users would still be able

to use existing open roads, but they may encounter some roads that are temporarily closed to public use in the Jacob-Ryan area.

Cumulative Effects to Visual Quality and Recreation

Previous vegetation management, fuels reduction projects, recreation developments, livestock grazing and historic forest management activities in the Jacob-Ryan area have all resulted in changes to the "natural appearing" landscape and to scenic integrity. The greatest factors have been the long-term results of historic logging practices and fire suppression, which have changed the historic tree age, structure, and distribution in the ponderosa pine forest. The development of Highways 89A and 67, along with the concentration of services and facilities at Jacob Lake, has increased the human impacts in the area. Although not specifically addressed in this project, the fire risk for the wildland-urban interface at Jacob Lake and other facilities remains. The hazard tree removal work recently accomplished by Arizona Department of Transportation along Highways 67 and 89A has opened up the road corridor dramatically. Current management activities nearby include the Warm Fire hazard tree removal and the Warm Fire reforestation project. There is also the potential for implementation of the Warm Fire salvage project. Future management activities proposed for this area include range improvement projects, improvements and expansion at Jacob Lake Inn, and improvements at Allen's Equestrian permit area. These activities, when combined with the proposed Jacob-Ryan Project, would result in increased evidence of management activity during project implementation. All these projects would result in short-term lowering of scenic integrity, but are expected to have a long-term positive effect on the landscape. These combined activities will reduce the visual quality of the area for 3-5 years. Time has already started to heal the highway corridor scarring with the regrowth of aspen and native vegetation. Therefore, the cumulative effect of the proposed action when added to these past, present, and foreseeable actions would not result in significant detrimental effects to the scenic integrity or recreation opportunities in the area.

Economics

Affected Environment

The economy in rural northern Arizona has traditionally been rooted in extractive uses such as grazing and timber. Over the past 15 years, there has been a shift towards non-extractive recreation-based uses. Between 1990 and 2000, the Forest had a drastic decrease in saw timber, pulpwood, and commercial fuel-wood permits. This shift resulted in the loss of jobs and economic hardship to some individuals in the community. Growth in recreation-related industries has helped somewhat to offset his trend.

The USDA Forest Service, Southwestern and Intermountain Regions, and the State of Utah have a memorandum of understanding (MOU 04-MU-11046000-060) to build “the capacity to accomplish restoration projects” and encourage “local employment in order to benefit the management of the national forests and communities of the Central Colorado Plateau and Great Basin”

Direct and Indirect Effects

Alternative 1 – No Action

Under the no-action alternative, there would be no thinning or prescribed burning. As a result, there would be no income generated from commercially-sized wood to offset costs incurred from implementing non-commercial thinning and prescribed burning. The project area would remain at risk for a high-intensity stand-replacing fire like the Warm Fire. High-intensity stand-replacing wildfires incur costs associated with suppression, post fire rehabilitation, and reforestation. Suppression costs of wildfire can exceed $1,000 an acre. Post-fire rehabilitation, including emergency soil stabilization and replanting, have high per-acre costs. Stand-replacing wildfires also cause losses to Forest resources which can have economic effects in the form of reduced tourism dollars and loss of commercial wood products. The no-action alternative would not meet the intent of the MOU.

Alternative 2 – Proposed Action

The proposed action would potentially generate about 48,500 CCF of commercial timber from thinning trees less than 18 inches DBH. The value of this timber may either be sold or traded as "goods for services" in a stewardship contact. Receipts from timber sales would help to offset the cost associated with implementation of the non-commercial thinning and prescribed burns. Due to fluctuations in timber prices, it is difficult to project the discrete economic effects of the proposed action. Further, the mix of small and large mills in the project area makes it problematic to identify the specific locations where economic effects would be felt the strongest. There is currently one small mill in operation in Fredonia, Arizona, and several more throughout the vicinity. Larger mills are in operation in Escalante, Utah and other areas a similar distance away from the project area.

Despite the challenge in identifying the specific quantity and location where economic effects would be felt the strongest, it is clear that a project of this size will have significant direct, indirect, and induced effects. Direct effects are the responses of an industry to demand for goods or services. Indirect effects are produced when a sector must purchase supplies and services from other industries in order to produce output sufficient to meet demand. The employment and labor income generated in other industries as a result are referred to as indirect effects. Induced effects represent the employment and labor income stimulated throughout the local economy as a result of the expenditure of new household income generated by direct and indirect employment. Induced effects often are felt multiple times over as revenues are spent and re-spent in different sectors of the economy.

Non-commercial thinning and prescribed burning have costs associated with implementation, but much of the costs are in the form of wages, which would result in beneficial indirect and induced effects. Indirect and induced economic effects would also result from the sale of merchantable timber and processing of wood products. Wood processed at locations far from Fredonia, Arizona could contribute to stimulation of the local economy through purchases such as fuel, food, and supplies. The proposed action would meet the intent of the MOU.

Alternative 3 – Twelve-inch Diameter Limit

Alternative 3 would generate approximately 12,900 CCF of commercial timber from thinning trees less than 12 inches DBH. Economic effects of Alternative 3 would be similar to Alternative 2, except it would generate only about one-quarter of the commercial wood volume. Alternative 3

would cost about the same to implement as the proposed action, but there would be less potential revenue available to help offset implementation costs.

Cumulative Effects

The analysis area considered for economic effects is for Kane County, Utah and Coconino County, Arizona, although the effects could reach into Washington and Garfield Counties in Utah, and Mohave County, Arizona as well. Tourism and recreation are the main industries for the immediate analysis area and have been expanded almost to their limits over the last 15 years to offset the decline of the wood products industry. The timeframe for potential economic benefit to these communities by implementing the proposed action is 10 years. Economic benefits reach beyond the salaries for those working the project, but also provide monetary infusions to the community in the form of rents, supplies (food/fuel) and related services. The Jacob-Ryan Project would provide an economic benefit to the communities; however the effect would likely be small as the total contribution of Kaibab National Forest activities are estimated to be responsible for only about 0.5 percent of the jobs and labor income within the regional economy (KNF 2008).

Environmental Justice

Affected Environment

On February 11, 1994 President Clinton issued Executive Order 12898, *"Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*." This Executive Order was designed to focus the attention of federal agencies on the human health and environmental conditions in minority and low-income communities. It requires federal agencies to adopt strategies to address environmental justice concerns within the context of existing laws, including NEPA. The goal of an environmental justice analysis is not to shift risks among populations, but to identify potential disproportionately high and adverse effects, and to identify alternatives that may mitigate these impacts.

There are large Hispanic and American Indian populations in the Southwest. Local Indian tribes were consulted regarding this proposal. Area tribal members use the area for personal collection of traditional and medicinal plants. Low-income groups use the area for the collection of fuel-wood.

Direct and Indirect Effects

Alternative 1 – No Action

The no action alternative does not reduce the risk of high-intensity, stand-replacing wildfire. Although all communities, wealthy and poor, suffer direct economic consequences when there are large wildfires, normal commercial activity can be disrupted. Many of the low-income jobs in the area are connected to tourism. Even a temporary loss of work can overwhelm low-income individuals and families. Fires can also reduce the availability of native plants and building supplies that sustain many traditional and indigenous communities.

Alternative 2 and 3 – Action Alternatives

Both action alternatives would reduce the risk of high-intensity stand-replacing wildfires, which would better protect the area resources and the communities that they serve.

CHAPTER 4: LIST OF PREPARERS AND CONSULTATION WITH OTHERS

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Bureau of Land Management, Kanab, Utah
National Park Service, Denver, Colorado
Arizona Game and Fish Department, Flagstaff, Arizona
Arizona Department of Transportation, Flagstaff, Arizona
Colorado City Mayor, Colorado City, Arizona
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Tribal organizations consulted

Kaibab Band of Paiute Indians
Navajo Nation
Hopi Tribe

Business and special interest groups

Grand Canyon Trust, Flagstaff, Arizona
Center for Biological Diversity, Flagstaff, Arizona
Sierra Club, Flagstaff, Arizona
Grand Canyon Wildlands Council, Flagstaff, Arizona
Ecological Restoration Institute, Flagstaff, Arizona
Arizona Greenworks, Flagstaff, Arizona

Vermillion Services, Kanab, Utah

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APPENDIX A: Supplemental Analysis to the EA

Introduction

The purpose of this addendum is to supplement the environmental effects analysis for the Jacob-Ryan Project on vegetation structural stage (VSS) and the status of old-growth at the larger ad hoc[1] and geographic area scales. This supplement also adds some clarification on how this analysis considered climate change and provide additional analysis describing the relationship between this project and the adjacent Warm Fire Recovery Project. Opposing science provided by the commenters was reviewed in detail and considered. Comments received on the Environmental Assessment (EA) were reviewed by the members of the project ID team and specialists in the Forest Supervisors' Office. Responses to comments are provided by affected resource in Appendix I.

Analysis scales for VSS per goshawk guidelines

The Forest Plan requires that the effects for vegetative structure are assessed at one scale smaller and larger than the project area. The analysis for the JR project was conducted at the strata level (even-aged and uneven-aged), the project level and at the larger ad hoc analysis area.

The Forest Plan was corrected in November 2008 to make language consistent between the Forest Plan and the Regional EIS for the 1996 Plan Amendments. Ecosystem Management Areas (EMAs) were renamed to Geographic Areas, but retained their numerical designations. Geographic Areas contain within them smaller management area landscapes that average 10,000 acres to 20,000 acres (Figure S1). These landscape areas are typically used for the large scale analysis. The Forest Plan allows the ID team to determine an ad hoc area for the large scale analysis if more appropriate for the analysis needs. Because the Jacob-Ryan Project contained portions of several landscapes, the ID team determined the combined landscapes would be appropriate ad hoc area for this large scale.

The ad hoc analysis area for the JR project includes six of those landscapes: Billy Sink, Buck Ridge, East Lake, Trail Canyon, Warm Oak, and Wild Horse (Figure S2). The Wild Horse and Buck Ridge landscapes contribute the majority of acreage to the ad hoc area. These landscapes were selected for the ad hoc area, because the project is within portions of each landscape and they are dominated by ponderosa pine similar to the JR project area. The ad hoc analysis area is about 78,000 acres; however, the existing old growth and structural stage (VSS) data for these analyses is limited to about 69,000 acres. The 9,000 acre difference is because there are remnant stringers of pinion pine, juniper and aspen, which are not being treated in the JR project. The large scale analysis area for old-growth is Geographic Area 13 (formerly EMA 13) and consists of about 250,000 acres. Existing and desired condition for strata and project level data are provided in Chapter 1 of the EA and the effects analysis for these two analysis scales are addressed in the silviculture section of Chapter 3.

3

[3] [1] Ad hoc as used in this analysis area definition is set up as a special case for only this project. It is used for large scale analysis for vegetation stage structure for goshawks and at the mid-scale analysis for the status of old-growth.

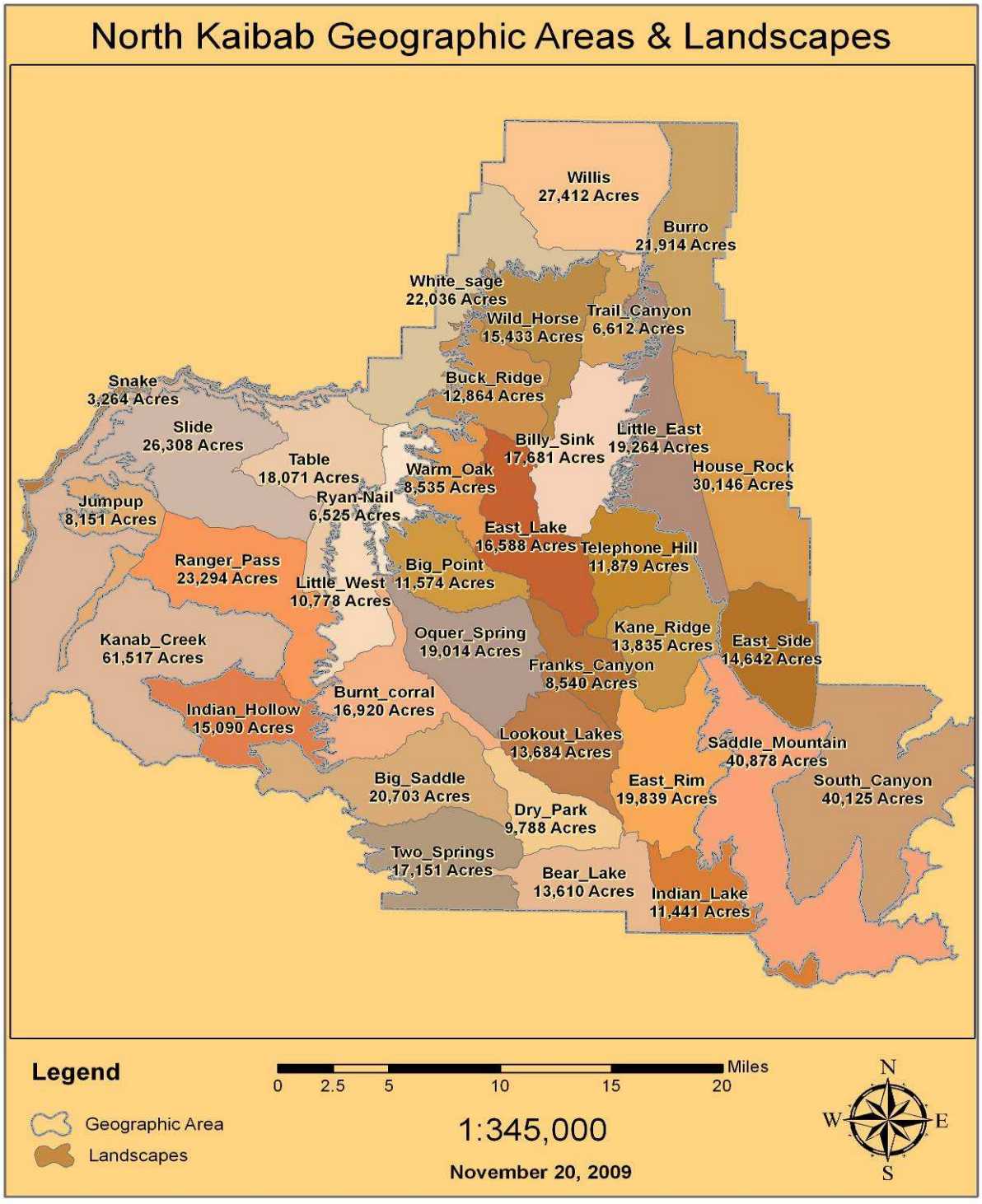

Figure S17—North Kaibab Geographic Areas and Management Area Landscapes

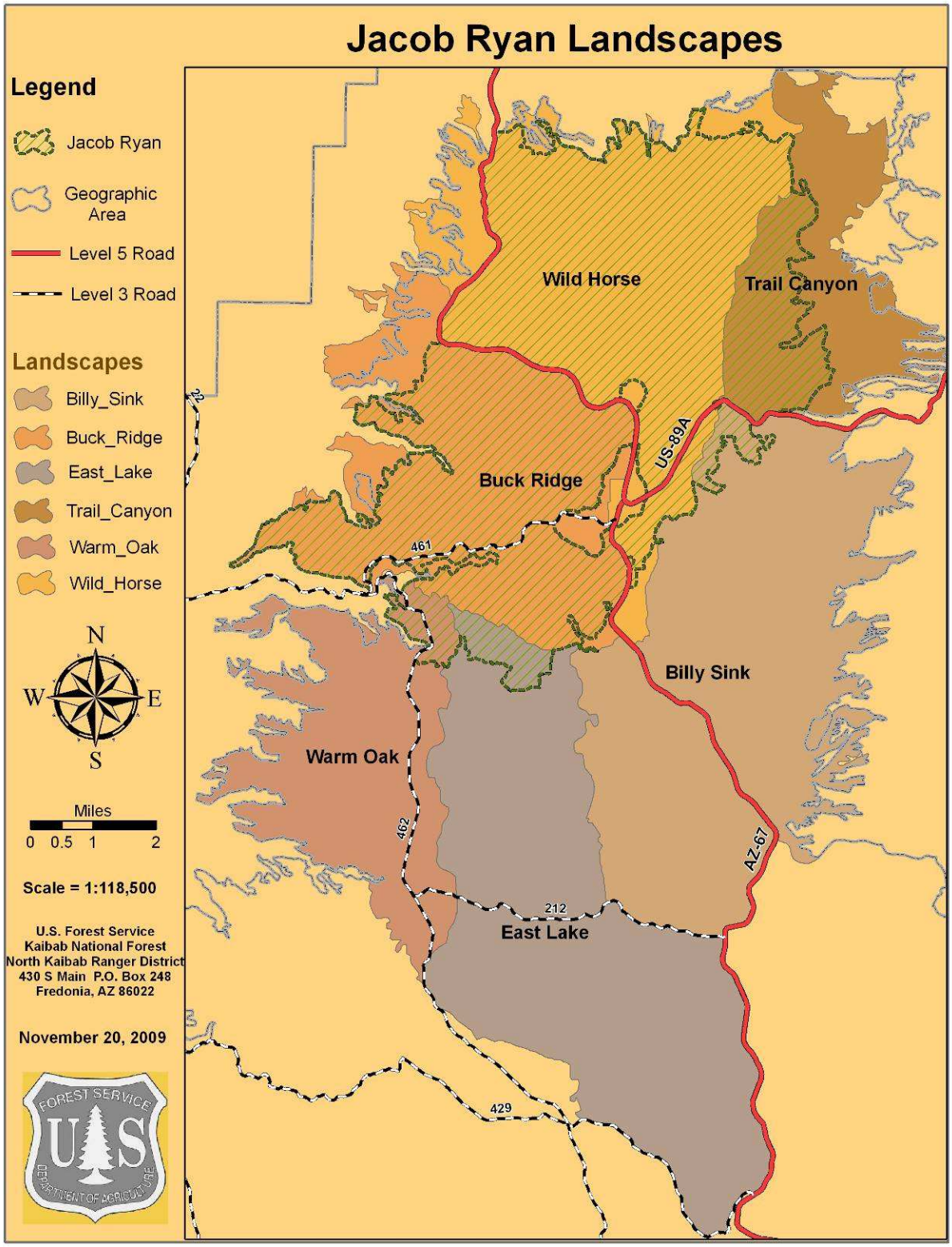

Figure S18—Landscapes making up the Jacob-Ryan ad hoc analysis area

Current Conditions in the Ad Hoc Area

This analysis area has the following stand averages:

- 853 trees per acre;
- 31.4 % canopy cover;
- basal area of 114 square feet per acre;
- average tree size of 5.9 inches; and a
- Stand Density Index of 247.

Direct and Indirect Effects for all Alternatives at the Ad hoc Scale

Alternative 1-No Action. There would be no change to the existing condition and trends for the ad hoc analysis area. The unchanged excesses in fuel loading and ladder fuels in this alternative along with dense growing conditions would leave the area at high risk for insects and disease and uncharacteristic stand replacing wildfire. It does not make progress toward the desired condition.

Alternative 2-Proposed Action. The direct effects from thinning trees up to 18 inches DBH would be: improved growth and vigor of residual trees; greater availability of light, nutrients, and moisture for trees, shrubs, forbs, and grasses; and a greater area dominated by VSS 5 and 6 classes.

Indirect effects of the proposed action in the ad hoc area would be increased resistance to crown fires, faster diameter growth, and greater progress toward the desired uneven-aged forest conditions. Canopy cover would increase over time in VSS 4 through 6 classes as a result of the reduced competition between trees. Residual trees would attain full and healthy crowns and over time the stands would be adapted to frequent low-intensity surface fires.

There are VSS data for 69,000 of the approximately 78,000 acres in the ad hoc area. This area includes Jacob-Ryan project and the six affected surrounding landscapes. Data for the ad hoc area shows that about 53 percent of the acreage is already made up of mature and old trees (VSS 5/6 - FSVEG data, 2008). Table S1 provides the distribution of VSS at the ad hoc scale. The proposed action and Alternative 3 would make progress toward a more desired uneven-aged forest structure in the ad hoc area by converting about 8,000 acres of even-aged stands over time.

Table S42—Current condition for VSS distribution of ponderosa pine in the ad hoc area

GROWTH STAGE	Grass/forbs and Shrubs	Seedlings Saplings	Young Forest	Mid-aged Forest	Mature Forest	Old Forest
SIZE	0 - 1”	1”-4.9”	5”-11.9”	12”-17.9”	18”-23.9”	24” over
VSS	1	2	3	4	5	6
EXISTING CONDITION (%)	5.2	4.8	21.2	*15.7	30.8	21.4
DESIRED CONDITION (%)	10	10	20	20	20	20
ESTIMATED ACRES IN 2008	3588	3312	14628	10833	15387	21252

*Both the project area (19%) and the ad hoc area (15.7%) appear to have deficits in mid-age forest (VSS4) structure. The reason for these below desired condition averages is that these percentages are averages across many thousands of acres. Some stands may have deficits in VSS4 trees while others may have a surplus. These sites with surpluses may have a continuous canopy make up not only requiring a reduction in tree numbers, but the creation of groups and suitable openings for better growth. Sites lacking in VSS4 trees would not have their numbers reduced and every effort would be made to increase this size class of trees.

Snags average about one tree per acre in both the JR project and the ad hoc analysis areas. The proposed action would retain large trees over 18 inches as future snags at dwarf-mistletoe infection centers or infected with other diseases or insects. The Warm Fire Recovery (suppression) area adjacent to the JR project, but outside the ad hoc analysis area, has thousands of snag trees that are soon to be downed logs and woody debris. The stand summary statistics for the ad hoc area reveal similar conditions to the JR project area. The stands are densely stocked with small trees. Inter-tree competition has increased, resulting in competition-induced mortality. The Stand Density Index is presently at 55 percent of maximum. Competition-induced mortality usually starts to occur between 57 percent and 60 percent. Improved tree vigor and fire resistance would be achieved by reducing tree density to about 150 trees per acre, distributed at the desired stocking levels for each VSS size class. This would result in a Stand Density Index reduction to about 35 percent of maximum.

The proposed action would increase the amount of down woody debris in the ad hoc area as tree cutting would lead to increased accumulation of slash. Coarse woody debris would also accumulate as snags topple from wind and fire. Meeting the average of 5 to 7 tons per acre of down woody debris in ponderosa pine would be achieved with design criteria of leaving activity slash on the site. Excesses in the amount of down woody debris would be pile burned before broadcast burning is initiated.

Alternative 3. Effects from Alternative 3 in the ad hoc area would be similar to the proposed action except that all trees over 12 inches would remain in place, thereby not treating excessive tree densities, infections centers and potential fire hazard conditions.

Direct and indirect effects for snags would show an increase in dead trees in all alternatives due to the retention of dwarf-mistletoe infested trees. Endemic levels of insect and disease agents would increase snags over time at the ad hoc scale.

Table S2 below summarizes the three analysis scales for VSS and goshawk guidelines in the Jacob-Ryan project.

Table S2—Analysis scales for VSS per goshawk guidelines in Jacob-Ryan

Forest Plan standards & guidelines for desired conditions	Strata Scale - Averages ~ 8,000 ac ~ 18,000 ac				Mid-Scale Anal. Area Project Area ~ 26,000 ac	Large Scale Analysis Area ad hoc-6 landscapes ~ 78,000 ac
VSS Percent by Acres	Even-age		Uneven-age		Weighted Average All Acres	Weighted Average All Acres
VSS 1 and 2 (20%)	11.3 %		8.0 %		9.0 %	
VSS 3 (20%)	36.8 %		19.0 %		24.6 %	VSS 1 – 3 about 31.2 %
VSS 4 (20%)	14.0 %		19.0 %		17.4 %	
VSS 5 (20%)	23.9 %		29.0		27.4 %	
VSS 6 (20%)	14.0 %		25.0 %		21.6 %	VSS 4 – 6 about 68.8 %
VSS Class	Even-age (tpa)		Uneven-age(tpa)		Project Area	Ad hoc Area
Trees per Acre (tpa)	PFA	Non-PFA	PFA	Non-PFA	Trees per Acre	Trees per Acre
VSS 1 (61)	40	57	190	136	190	About 853 trees per acre
VSS 2 (41)	239	192	182	213	198	Data not broken out by
VSS 3 (31)	38	35	70	59	65	species, only total trees/acre
VSS 4 (16)	9	11	20	22	20	
VSS 5 (11)	4	5	13	14	13	Includes all tree species
VSS 6 (7)	2	2	6	7	7	
Canopy Cover Percent	Even-age		Uneven-age		Project Area	Ad hoc Area
VSS 4/5/6, 40% to 70%	PFA	Non-PFA	PFA	Non-PFA		
	~10.0%	~11.0%	~23.%	~23.0%	~20.0%	~ 31.0%
Snags = 2 per acre	Even-age		Uneven-age		Project Area	Ad hoc Area
18” DBH & 30’tall	<1 snag / acre		1.1 snag / acre		~ 1 snag / acre	~ 2 snags / acre, includes 10K
						acres in Warm Fire use area
Logs = 3 per acre	Even-age		Uneven-age		Project Area	Ad hoc Area
>12” DBH & 8’ long	~ 3 logs / acre		~ 3 logs / acre		~ 3 logs / acre	~ 3 plus logs / acre, see below
Down Woody Material	Even-age		Uneven-age		Project Area	Ad hoc Area
3” or greater on forest floor	~3-7 tons / acre		~ 10-15 tons / acre		~ 14 tons / acre	~ 9 – 10 tons / acre, will increase when snags in Warm Fire fall

Nest areas and dwarf-mistletoe acreages and percentages added into PFA and Non-PFA totals.
Primary treatment emphasis is for thinning in VSS 2 and VSS 3. No reductions in VSS 5/6 and only minimal reductions for VSS 4 when sites exceed the desired condition.

Table Summary for VSS Analysis Scales

The proposed action would make more progress toward, but not achieve the desired conditions in the Forest Plan. Both action alternatives would progress toward the desired amount of snags, logs & down woody material through implementation design criteria.

Alternative 1 would not change the existing condition for dense stand structures with stunted tree growth and competition-induced mortality. There would be no change to the existing trend, resulting in an increase in ladder fuels, fuel loading, and the risk of wildfire, insects and disease.

Alternative 2 (Proposed Action) would create defined tree groups and open areas that would enhance tree growth and create more interlocking group canopy cover. It would improve the uneven-aged structure by 30% in the project and ad hoc areas, thereby creating more and better goshawk habitat. Design and mitigation criteria specified in the JR proposed action retains and promotes mature and old trees (vss5/6) as well as pre-settlement trees and moves the ponderosa pine community toward the desired condition in the plan. Mature and old trees (VSS 5/6) in the Warm Fire suppression area are currently about 8%, but mature and old trees (VSS 5/6) continue to represent about 19% of the GA 13 analysis scale.

Implementing Alternative 3 would have similar effects to Alternative 2 except it would not make as much progress toward the desired condition. If current trends continue, the area would eventually become more even-aged.

What is Old-Growth

Forest Plan standards for old-growth are based on specific forest characteristics. The data used to identify old-growth at the different scales are based on FSVEG/stand exam data (Project Record-PR41). Old-growth is defined in the Forest Plan as:

- at least 20 trees per acre that are 18 inches DBH and greater, and 180+ years old;
- a basal area in the stand of at least 90 square feet per acre;
- at least 1 snag per acre that is 12 inches or greater at DBH, and at least 25 feet high;
- at least 2 downed woody pieces 12 inches or greater at DBH, and 15 feet or longer; and
- 50 percent or greater in canopy cover.

Mature and old trees (VSS 5/6) by themselves do not constitute old-growth; they need the combined attributes listed above. Old-growth forest structure includes accumulation of large dead and fallen trees, tree decadence in the form of broken or deformed tops, and diseased trees (Hamilton 1993). Old-forest conditions develop over time and can be managed to promote old-growth. However, in arid southwestern ponderosa pine forests, disturbance regimes, especially uncharacteristic crown fire, can keep forests in early to mid-seral stages that delay the onset of *old-forest* features.

Important historical features for ponderosa pine forests in the arid Southwest were high-frequency low-severity fires and varied patterns of tree establishment. Tree recruitment occurred in small groups of relatively even-aged trees in multiple associates (Kaufmann et al. 2007). These groups could also be described as patches and clusters.

Old-growth forests or "landscapes contain sufficient numbers of patches and stands of old-growth to be reasonably representative of the forest type in historical times" (Kaufmann et al. 2007). These landscapes can be in various stages of development including temporary openings or patches of very young trees, which provide future old-growth patches in the landscape (Kaufmann et al 2007). Old-growth descriptions and definitions are complex in the fire-adapted ecosystems of the Southwest compared to the lush old-growth rainforests of the Pacific Northwest. Frequent surface fires resulted in patches of seedlings becoming established when there was enough moisture for seed production, germination, and seedling survival.

Historically, there was a shifting mosaic of *old-forest* conditions in uneven-aged groups and clusters. The desired condition for the Jacob-Ryan project is the promotion and maintenance for a shifting mosaic of old-growth patches that meet the desired percentage for old trees across the ad hoc landscape and the larger Geographic Area. The ad hoc analysis area shown in Figure S2 combines the current condition for six landscapes of old-growth trees. At the Geographic Area, the largest level of analysis, we gauge our current old growth condition against relevant past disturbances, especially those from the 2006 Warm Fire. The current and predicted acres of old-growth were analyzed by strata based on the characteristics listed above.

Status of Old-Growth

Even-aged Stands

Most remaining even-aged stands were harvested in the 1980's and 1990's with shelterwood treatments. They are currently lacking old-growth characteristics and it would take decades and

several treatments before they are considered old-growth. The proposed action includes thinning these dense, overstocked stands and creating forest openings that would make progress toward an uneven-aged structure while improving stand and tree vigor.

Uneven-aged Stands

Currently, there are about 1,800 acres with old-growth characteristics in the project's uneven-aged areas, which make up about 10 percent of the uneven-aged forest in JR. Old-growth in dwarf-mistletoe infected areas increase that amount to about 12 percent. The JR project area has been harvested since the early 1970's with various treatments. The Individual Tree Selection method was light on the land and harvested only a few trees per acre. Many overstory trees were left in place in more than 13,000 harvested acres (Project record, GIS map/table). Some of these stands now have old-growth characteristics.

The proposed action would leave all trees greater than 18 inches DBH to conserve and enhance old-growth in clumps and groups as well as any trees less than 18 inches having old-growth characteristics as described in the EA. This way, any stand vegetation management under the Forest Plan could achieve or move toward having at least 20 percent old-growth that in time would meet other old-growth requirements for large trees. Those requirements include having a basal area greater than 90 square feet per acre and the appropriate amount of canopy cover for goshawk foraging (FA) and post-fledging family areas (PFA).

The proposed action would promote a higher percentage of old-growth by 2053 through a combination of treatments that would maintain a sustainable size class distribution over time. This treatment would improve diameter growth, resulting in more large trees faster. Treatments in the project area (small scale) do not directly affect old-growth because the proposed action does not remove mature and old trees (VSS 5/6). It does, however protect existing old-growth and promote future old-growth in ponderosa pine. Thus, the proposed action would move the project area stands and landscapes toward the desired conditions in the Forest Plan.

Dwarf-mistletoe infected stands include about 300 acres of old-growth, but are not sustainable over time. As large infested trees die, key features like basal area and canopy cover decrease. Left untreated, there is a risk for a conversion in infested ponderosa pine stands to grasses, forbs and shrubs. The risk of uncharacteristic, high-intensity fire in these stands increases as these trees die and ground fuels accumulate. The proposed action would improve forest health by removing some infected trees, reducing tree density and creating openings around residual trees.

A benefit of the proposed action is that thinning and prescribed fire would eventually create favorable conditions for the growth and development of healthy forest stands resistant to periodic wildfire and fire use. The proposed action would also promote other old-growth attributes such as large trees per acre, snags, woody debris, and suitable canopy cover. The desired condition over time is an uneven-aged forest composed of clumps and groups of trees where large landscape percentages meet old-growth conditions and not specific acres. Maintaining large trees on the landscape and by reducing competition from small trees, the forest would grow more mature and old trees (VSS 5/6) at the project, ad hoc and Geographic Area levels.

The adjacent Warm Fire impacted old-growth at both the ad hoc scale in the wildland fire-use area and the Geographic Area scale with the estimated loss for old growth at about 6,200 acres. Even with the Warm Fire losses, there are about 16,000 acres (23%) at the ad hoc scale and 53,000 acres (19.7%) at the Geographic Area remaining in old-growth (Table S3). These data

were collected prior to the 2006 Warm Fire when there would have been about 59,000 acres (23.8%) of old-growth in Geographic Area 13. Table 4 below presents the current VSS distribution in the Warm Fire suppression area and points to the lack of the desired forest structure.

Table S3—Estimated old-growth by community type within Geographic Area 13

	Ponderosa Pine	Quaking Aspen	Mixed Conifer (included Spruce/Fir)	Grand Total
Total Acres by Cover Type	175,710	2,025	51,050	248,785
Existing OG – EMA 13	43,767	10,480	4,894	59,141
% of Area OG	24.9%	47.6%	9.6%	23.8%

(Data from Jacob-Ryan Vegetation Management Project, Silviculture Report, T. Howard, 2003)

Table S4—VSS analysis for the Warm Fire suppression area at the current condition.

VSS	Dominant Tree Diameter (DBH)	Structural Stage Description	Percent of Area
1	Less than 1 inch	Grass / Forbs / Shrubs (non-stocked)	67 %
2	1 inch to 4.9 inches	Saplings / Seedlings	1 %
3	5 inches to 11.9 inches	Young Forest	6 %
4	12 inches to 17.9 inches	Middle-aged Forest	9 %
5	18 inches to 23.9 inches	Mature Forest	8 %
6	24 inches and over	Old Forest	9 %

(Data prepared by T.E.A.M.s; Lois Pfeffer, Team Leader, FEIS Warm Fire)

There are currently deficits of old-growth at the project level (7%), a small surplus (23%) in the ad hoc analysis area, and about the desired amount (19.7%) at the Geographic Area level. Old-growth areas are going to increase proportionately as the forest moves toward the desired uneven-aged structure.

Table S5 below summarizes the status of old-growth trees at and across the three levels of analysis in the JR project.

Table S5—existing condition of old-growth at the three levels of analysis for the Jacob-Ryan Project

Forest Plan Standard and Guidelines for desired condition	Smallest scale JR Project Area Ponderosa pine ~26,000 acres	Mid-scale, Ad hoc, Combined landscapes (6) Ponderosa pine ~ 69,000 acres	Large scale Geographic Area (GA) Multi-species ~ 250,000 acres	Summary for compliance with Forest Plan standards and guidelines
Allocate a minimum of 20% old-growth in each ecosystem management area (now Geographic Area) and must contain the 5 criteria above.	~ 7.0 %	~ 23.0 %	~ 19.7 %	Approaching desired condition of 20.0% ~ 23.8 % old-growth at the Geographic Area scale prior to the Warm Fire

(1) VSS = Vegetative Structural Stage (definition in glossary)
(2) No data when community type changed to pure pinyon/juniper.
(3) There would be no immediate change in the amount of old-growth acre percentages following treatment activities. However, there is an expected increase in old-growth acre percentages of 76.0% over the next 45 years (2053) following proposed action activities.

Climate Change Considerations

Projected climate change impacts include air temperature increases; sea level rise; changes in the timing, location, and quantity of precipitation; and increased frequency of extreme weather events such as heat waves, droughts and floods. The changes would vary regionally and affect renewable resources, aquatic and terrestrial ecosystems and agriculture.

Projects like Jacob-Ryan that are designed to restore the health, resilience and productivity of forested ecosystems would improve the ability of the landscape to endure climate change stresses. Thinning reduces between tree competition for light, moisture and nutrients improving tree vigor. The remaining trees would be more able to survive wildfire, disease and insect attacks when stressed by drought.

Alternative 3 would leave more trees and have denser forest conditions than Alternative 2. Alternative 2 would reduce tree density, which would increase forest resilience and decrease the potential for large uncharacteristic wildfires.

Prescribed burning of both action alternatives would emit short-term greenhouse gases locally over a 5 to 10 year period, but they would reduce the risk of an uncharacteristic high-intensity wildfire. High intensity crown fires emit far more greenhouse gases than low intensity ground fires (EA, Tables 26, 27 & 28, page 46).

Large Tree Mortality

The Jacob Ryan project intends to re-introduce surface fire regime to ponderosa pine stands. Prescribed burning would not be implemented in the same year as mechanical treatments to reduce the incidence of post treatment mortality (EA, Appendix H, page 113). The burn plan would incorporate acceptable ignition patterns and techniques to reduce burn intensity near large leave trees. The burn prescription has mortality factors built into the models, and design criteria along with Best Management Practices would be followed to minimize tree mortality.

Most post surface-fire mortality mentioned relates to areas with basaltic soils not the limestone soils of the Kaibab Plateau. There is a difference in soil composition and root depth between basaltic, lava soils, and limestone-derived soils on the North Kaibab. Trees on the North Kaibab have deeper root structures and are protected from surface fire. The Mount Trumbull study sites were on two edges of a large, shallow-soiled lava flow where tree roots were at or close to the surface. The area had been fire free for 130 years and experienced severe drought in 1989, 1996, and 2000. Thinning and the removal of excess fuel loads were not done prior to burning the area and there was no wind to move the fire through the site. Therefore, the fire intensity exceeded prescribed levels mortally injuring leave trees. The study showed and the authors recommended thinning treatments for forests on lava soils and having the appropriate weather conditions before initiating prescribed burns (Fule et al. 2002).

Accomplishing successful prescribed burns requires thinning of the existing over story, reducing fuel loads and ladder fuels. Excess slash generated from thinning activities would be piled and burned at landings or within the existing units during times of significant moisture, usually during late fall, winter, or early spring when snow is present. Pre-burn preparation would include pulling excess duff and activity slash away from tree drip lines and boles before igniting the burn. Finally, burn conditions are checked with a test burn to establish intensity before a prescribed fire is initiated. The North Kaibab Ranger District has successfully completed multiple prescribed burns in the past with its level of pre-burn preparation.

Canopy Cover Measurements

The Forest is using the 2005 version of the Kaibab NF Interpretation and Implementation guidelines not the 2007 Region 3 suggested guidelines. The Kaibab Forest Plan describes the Guidelines for Ecosystem Management in Northern Goshawk Habitat that includes canopy cover at multiple levels (Forest Plan, page 30). Currently, canopy cover is evaluated at the stand level because our data is measured at the stand or site level. Forest Plan guidelines recommend canopy cover from 40 percent to 70 percent for mid-aged, mature and old forests (VSS 4 through VSS 6) in nest areas, post-fledging areas and outside post-fledging areas across landscapes (KNF LRMP p. 30). Management activities are targeting mostly VSS 2 and VSS 3. Only sites with surpluses would receive treatments in that size class. Treatments in sites with deficits in VSS 4 would not remove this size class. Since the Jacob-Ryan project targets 60 percent of the acres in VSS 4 through VSS 6, we believe goshawk habitat requirements for canopy cover would eventually be met with improved tree growth following vegetation treatments.

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APPENDIX B: Glossary

Active Crown Fire: A crown fire in which the entire fuel complex becomes involved, but the crowning phase remains dependent on heat released from the surface fuels for continued spread, also called running and continuous crown fire.

Age Class: A distinct group of trees recognized on the basis of age.

Bark Beetle: An insect that bores through the bark of forest trees to eat the inner bark and lay its eggs.

Best Management Practices (BMPs): "Methods, measures or practices selected by an agency to meet its non-point source control needs. BMPs include, but are not limited to, structural and nonstructural controls, operations, and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters" (EPA Water Quality Standards Regulation, 40 CFR 130.2).

Broadcast Burn: Allowing a prescribed fire to burn over a designated area within well-defined boundaries, for reduction of fuel hazard, as a silvicultural treatment, or both.

Canopy Closure: The amount of canopy cover that (forest layers above one's head) blocks the sunlight or obscures the sky. It can only be determined from measurements taken under the canopy as openings in the branches and trees must be accounted for.

Canopy/Crown: The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees.

Catastrophic: A violent or sudden change in a feature of the earth.

Classified Road: Road wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long-term motor vehicle access, including State roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service (36 CFR 212.1, FSM 7705 – Transportation System).

CFR: Code of Federal Regulations.

Conifer: A tree that produces cones, such as a pine, spruce or fir tree.

Consultation: A process required by Section 7 of the Endangered Species Act whereby Federal agencies proposing activities in a listed species habitat confer with the U.S. Fish and Wildlife Service about the impacts of the activity on the species. Consultation may be informal, and thus advisory, or formal, and thus binding.

Critical Habitat: That portion of a wild animal's habitat that is critical for the continued survival of the species. Under the Endangered Species Act, specific area designated for that species that is essential to survival of the species and which may require special management or protection.

Cultural Resource: The physical remains (artifacts, objects, structures, etc.) of past human activities.

Cumulative Effects: The impact on the environment, which results from the incremental impact of the action when added to other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time or space.

DBH (dbh): See Diameter Breast Height

Density (Stand): The number of trees growing in a given area usually expressed in terms of trees per acre.

Diameter Breast Height (DBH): Tree diameter, measured 4.5 feet above ground.

Direct Effect: Effects on the environment that occur at the same time and place as the initial cause or action.

Dispersed Recreation: Dispersed recreation includes individual activities performed outside of developed recreation sites. This includes activities such as scenic driving, hiking, bicycling, backpacking, hunting, fishing, snowmobiling, horseback riding, cross-country skiing, and recreation in primitive environments.

Disturbance (Ecosystem): Refers to events (either natural or human caused) that alter the structure, composition, or function of terrestrial or aquatic habitats.

Diversity: The distribution and abundance of different plant and animal communities and species.

Duff: The humus layer of decaying plant material between the surface litter and mineral soil.

Early Seral: A stage of development of an ecosystem from a disturbed, relatively un-vegetated state, to a plant community that is up to about 30 years old. Stand structure is seedling and sapling sized.

Ecosystem: A functional unit consisting of all the living organisms in a given area, and all of the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size, but it always functions as a whole unit.

Ecosystem Management: The careful and skillful use of ecological, economic, social, and managerial principles in managing ecosystem integrity and desired conditions, uses, products, and services over the long term.

Effects: Impacts resulting from actions that may have beneficial or detrimental consequences. Effects are usually ecological (such as the effects on natural resources and on the components, structures, and functions of affected ecosystems), that include aesthetic, historical, cultural, economic, social, or health, whether direct, indirect, or cumulative.

Endangered Species: A plant or animal species in danger of extinction due to environmental impacts throughout all or a significant portion of its home range. Endangered species are identified by the Secretary of the Interior in accordance with the Endangered Species Act of 1973.

Endemic: A species whose natural occurrence is confined to a certain region and whose distribution is relatively limited.

Environmental Assessment (EA): EAs were authorized by the National Environmental Policy Act (NEPA) of 1969. They are concise, analytical documents prepared with public participation that determine if an environmental impact statement (EIS) is needed for a particular project or action. If an EA determines an EIS is not needed, the EA becomes the document allowing agency compliance with NEPA requirements.

Environmental Impact Statement (EIS): A document prepared by a Federal agency in which anticipated environmental effects of a planned course of action or development are evaluated. A Federal statute (Section 102 of the National Environmental Policy Act of 1969) requires that such statements be prepared. It is prepared first in draft or review form, and then in final form. An impact statement includes the following points: (1) the environmental impact of the proposed

action; (2) any adverse impacts which cannot be avoided by the action; (3) the alternative courses of action; (4) the relationships between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and (5) a description of the irreversible and irretrievable commitment of resources which would occur if the action were accomplished.

Fine Fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a time lag of 1 hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Fire Behavior: How fire reacts to the influences of fuel, weather and topography.

Fire Exclusion: The policy of suppressing all wildland fires in an area.

Fire Frequency: The number of fires occurring within a specified area and time period.

Fire Size or Fire Extent: The size (hectares) of an individual fire, or the statistical distribution of individual fire sizes, or the total area burned by all fires within a specified time period.

Fire Interval: The number of years between successive fires, either within a recurrence interval, specified landscape, or at any single point within the landscape.

Fire Management Plan: A strategic plan that defines a program to manage wildland and prescribed fires and documents implementation strategies for the fire management program in the approved forest land and resource management plan alternative. The fire management plan is supplemented by operational plans, such as preparedness, dispatch, prescribed fire and prevention plans.

Fire Regimes: Refers to the role of fire in an ecosystem. It includes fire frequency, seasonality, intensity, duration and scale (patch size), as well as periodicity or variability.

Fire Return Interval: Number of years between fires at a given location.

Fire Season: The time of year at which fires occur, for example, spring and fall fires, when most plants are semi-dormant and relatively less vulnerable to fire injury, or summer fires when most plants are metabolically active and relatively more vulnerable to fire injury.

Fire Intensity: The amount of heat energy released during a fire, rarely measured directly, but sometimes inferred indirectly from fire severity.

Fire Severity: A fire's effects on organisms and the physical environment.

Forbs: A plant with a soft, rather than permanent woody stem, that is not a grass or grass-like plant.

Forest Land and Resource Management Plan (FLRMP): A national forest's land and resource management plan, which gathers and coordinates the direction to be followed in the overall

Forest Road: As defined in Title 23, Section 101 of the United States Code (23 U.S.C. 101), any road wholly or partly within, or adjacent to, and serving the National Forest System and which is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources. (FSM 7705 – Transportation System)

Forest Supervisor: The official who is responsible for administering the National Forest System lands in a Forest Service administrative unit, which may consist of one or more national forests.

Forest Transportation System Management: The planning, inventory, analysis, classification, record keeping, scheduling, construction, reconstruction, maintenance, decommissioning, and other operations undertaken to achieve environmentally sound, safe, cost-effective, access for use,

protection, administration, and management of National Forest System lands. (FSM 7705 – Transportation System)

Fuel: Combustible material that includes vegetation such as grass, leaves, ground litter, plants, shrubs and trees (see "Surface Fuels"). Includes both living plants; dead, woody vegetative materials; and other vegetative materials which are capable of burning.

Fuel Loadings: The oven dry weight of fuels in a given area, usually expressed in tons per acre. Fuel loadings may be referenced to fuel size or time lag categories; and may include surface fuels or total fuels. The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area.

Fuels Management: Manipulation or reduction of flammable matter for the purpose of reducing the intensity or rate of spread of a fire, while preserving and enhancing environmental quality.

Fuel Model: A set of surface fuel bed characteristics (load and surface-area-to-volume-ratio by size class, heat content, and depth) organized for input to a fire model. Standard fuel models (Anderson 1982) have been stylized to represent specific fuel conditions.

Fuel Reduction: Manipulation, including combustion or removal of fuels, to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.

Geographic Information System (GIS): Computer software that provides database and spatial analytic capabilities.

Heritage Resource: Any definite location of past human activity identifiable through field survey, historical documentation, or oral evidence. This includes archeological and architectural sites or structures, and places of traditional cultural or religious importance to specified groups whether or not represented by physical remains.

Hydrologic: Pertaining to the quantity, quality, and timing of water yield.

Homogenous: All of the same or similar kind or nature.

Hydrophobic: Water repellent.

Indirect Effect: Secondary effects which occur in locations other than the initial action or significantly later in time.

Interdisciplinary Team (IDT): A group of individuals with varying areas of specialty assembled to solve a problem or perform a task. The team is assembled out of recognition that no one discipline is sufficiently broad enough to adequately analyze the problem and propose action.

Landscape: An area composed of interacting and interconnected patterns of habitats (ecosystems) that are repeated because of the geology, landform, soils, climate, biota, and human influences throughout the area. Landscape structure is formed by patches (tree stands or sites), connections (corridors and linkages), and the matrix. Landscape function is based on disturbance events, successional development of landscape structure, and flows of energy and nutrients through the structure of the landscape. A landscape is composed of watersheds and smaller ecosystems. It is the building block of biotic provinces and regions.

Late-Seral Stage: A later stage of development of an ecosystem. Forested stands are generally 12 to 20+ inches average DBH.

Legacy Tree: A tree established before European settlement of the Kaibab Plateau, which is generally thought to be the year 1880.

Litter: Organic material including grasses, needles, twigs, and leaves on the soil's surface.

Maintenance: The upkeep of the entire forest development transportation facility including surface and shoulders, parking and side areas, structures, and such traffic-control devices as are necessary for its safe and efficient utilization (36 CFR 212.2(i)).

Maintenance Level: Defines the level of service provided by, and maintenance required for, a specific road, consistent with road management objectives and maintenance criteria. (FSH 7709.58, Sec 12.3 – Transportation System Maintenance Handbook)

Management Action: Any activity undertaken as part of national forest administration.

Mesic: Adapted to an environment having a balanced supply of moisture.

Monitoring: The process of collecting information to evaluate if objectives and anticipated or assumed results of a management plan are being realized, or if implementation is proceeding as planned.

Mosaic: A mix of stand structure and composition caused by disturbance. In the case of wildland fire, the word depicts widely varying fire effects.

National Environmental Policy Act (NEPA) of 1969: An act to declare a National policy which will encourage productive and enjoyable harmony between humans and the environment, to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, to enrich the understanding of the ecological systems and natural resources important to the nation, and to establish a Council on Environmental Quality. (The Principal Laws Relating to Forest Service Activities, Agriculture Handbook No. 453, USD, Forest Service, 359 pp.)

National Forest Management Act (NFMA): A law passed in 1976 requiring the preparation of regional guides and forest plans and regulations to guide that development.

National Forest System: All national forest lands reserved or withdrawn from the public domain of the United States.

Natural Regeneration: Renewal of a tree crop by natural seeding, sprouting, suckering, or layering.

Need: Circumstances in which a thing or course of action is required (reason for action).

Neotropical Migratory Birds: Migratory bird species that nest in North America and winter in Central or South America or in the Caribbean.

Noxious Weed: A legal term applied to plants regulated by Federal and state laws, such as the Secretary of Agriculture or responsible state official. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insect or disease, and being not native or new or not common to the United States.

Off-Road/Highway Vehicle (ORV, OHV): Any vehicle capable of being operated off an established road or trail.

Old Growth Forest: Stands with trees greater than 32-inch DBH, and significant amounts of dead wood and trees with large limbs, cavities and mistletoe brooms.

Overstory: The portion of the trees that form the uppermost canopy layer in a forest of more than one story.

Prescribed Fire: The intentional application of fire to wildland fuels in either their natural or modified state under such conditions as allow the fire to be confined to a predetermined area and at the same time to produce the intensity of heat and rate of spread required to further certain planned objectives (i.e., silviculture, wildlife management, etc.). Any fire ignited by management actions under certain, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.

Prescription: Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economic, public health, and environmental, geographic, administrative, social, or legal considerations.

Project: An organized effort to achieve an objective, identified by location, activities, outputs, effects, and time period, and responsibilities for execution.

Public Involvement: A Forest Service process designed to broaden the information base upon which agency decisions are made by: (1) informing the public about Forest Service activities, plans and decisions; and (2) encouraging public understanding about and participation in the planning processes leading to final decision making.

Purpose: An intended result, something for which an effort is being made (objective).

Reforestation: The renewals of forest cover by seeding, planting, and natural means.

Regeneration: The process of establishing a new tree crop on previously harvested land. The term also refers to the young crop itself.

Rehabilitation: The activities necessary to repair damage or disturbance caused by wildland fires or the fire suppression activity.

Restoration: In the context of the cohesive strategy, restoration means the return of an ecosystem or habitat toward: its original structure, natural complement of species, and natural functions or ecological processes.

Rill Erosion: Erosion that forms many small but conspicuous water channels.

Riparian: A geographic area containing an aquatic ecosystem and the adjacent upland areas that directly affects it. This includes flood plains, woodlands, and all areas within a specified distance from the normal line of high water of a stream channel, or from the shoreline of a standing body of water.

Road Maintenance: The ongoing upkeep of a road necessary to retain or restore the road to the approved road management objective. (FSM 7705 – Transportation System)

Road Reconstruction: Activity that results in a road improvement or road realignment of an existing classified road. (FSM 7700 – Transportation System)

Roadless Area: A National Forest area which: (1) is larger than 5,000 acres, or if smaller than 5000 acres, contiguous to a designated wilderness or primitive area; (2) contains no roads; and (3) has been inventoried by the forest system for possible inclusion in the wilderness preservation system.

Salvage: Harvest of trees that are dead, dying, or deteriorating due to fire, wind, insect or other damage or disease.

Scorch: Brown needles due to proximal heating where foliage did not catch fire.

Scoping Process: Activities in the early stages of preparation of an environmental analysis to determine public opinion, receive comments and suggestions, and determine issues during the environmental analysis process.

Sediment: Solid material, both mineral and organic, that is in suspension, being transported, or has been moved from the site of origin by air, water, gravity, or ice.

Sensitive Species: Species that have appeared in the Federal Register as proposed for classification and are under consideration for official listing as endangered or threatened species, that are on an official state list, or that are recognized by the regional forester as needing special management to prevent their being placed on Federal or state lists.

Seral: A transitory stage in an ecological succession.

Sheet Erosion: The removal of a fairly uniform layer of soil from the land surface by runoff water, without the development of conspicuous water channels.

Silviculture: Generally, the science and art of cultivating (i.e. growing and tending) forest crops based on knowledge of silvics.

Size Class: Intervals of tree diameters used to classify timber. Size class includes seedling/sapling, pole timber, and saw timber.

Snag: Standing dead tree larger than 6 inches in diameter at breast height.

Soil Wood: Small bits of wood in the soil.

Soil Productivity: The capability of a soil to produce a specific crop such as fiber and forage, under defined levels of management.

Spall: A chip, fragment, or flake from a piece of stone.

Stand: A community of trees or other vegetative growth occupying a specific area, and sufficiently uniform in composition (species), age, spatial arrangement, and conditions as to be distinguishable from the other growth on adjoined lands, so forming a silvicultural or management entity.

Standards and Guidelines: Requirements found in a forest plan which impose limits on natural resource management activities, generally for environmental protection.

Sub-watershed: A drainage area of approximately 20,000 acres.

Suppression: The act of extinguishing or confining a fire.

Surface Fuels: Consist of grasses, shrubs, timber litter, and woody material lying on the ground.

Temporary Road: Road authorized by contract, permit, lease, other written authorization, or emergency operation not intended to be a part of the forest transportation system and not necessary for long-term resource management. (36 CFR 212.1, FSM 7705 – Transportation System)

Threatened Species: A plant or animal identified and defined in accordance with the 1973 Endangered Species Act, and published in the Federal Register.

Trail: For purposes of travel by foot, stock, mechanized or motorized trail vehicle (less than 50″ in width).

Trailhead: The parking, signing, and other facilities available at the start of a trail.

Unclassified Roads: Roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travel ways, and off-road vehicle tracks that have not been designated and managed as a trail; and those roads that were once under permit or other authorization and were not decommissioned upon the termination of the authorization (36 CFR 212.1, FSM 7705 – Transportation System).

Understory: The portion of vegetation that is underneath the dominate tree canopy.

Vegetation Structural Stage (VSS): A Generalized description of forest growth and aging stages based on the majority or plurality of trees in the specific diameter distribution of the stand. Six growth stages are identified in Table 29 below. For instance, if the majority of the stems in a stand (based on basal area) were in the 12- to 18-inch diameter class the stand would be classified as a VSS 4. Stand vegetation dominance (VSS class) can occasionally be misleading. For example, a stand may have a few large trees that provide a high basal area and a great many small seedling/sapling sized trees underneath that contribute little basal area to the ratio. This stand could be categorized at a larger VSS class even though the majority of the trees requiring thinning are in a smaller category. Therefore, this structural classification system should be used as a guide to management over a project or landscape area rather than for individual stands.

Table 43—VSS classification and northern goshawk habitat

	VSS 1	**VSS 2**	**VSS 3**	**VSS 4**	**VSS 5**	**VSS 6**
Range of tree sizes for each growth stage	Less than 1”	1”-4.9”	5”-11.9”	12”-17.9”	18”-23.9”	24” over
Tree age or growth stages	Grass/forbs and Shrubs	Seedlings Saplings	Young Forest	Mid-aged Forest	Mature Forest	Old Forest
Basal area/acre for PFAs	0	2 ft²/ac	12 ft²/ac	19 ft²/ac	27 ft²/ac	30 ft²/ac
Basal area/acre for FAs	0	1 ft²/ac	8 ft²/ac	12 ft²/ac	20 ft²/ac	23 ft²/ac
Recommended Area Distribution (%)	(open area) 10	10	20	20	20	20

Watershed: The drainage basin contributing water, organic matter, dissolved nutrients and sediments to a stream, lake or river.

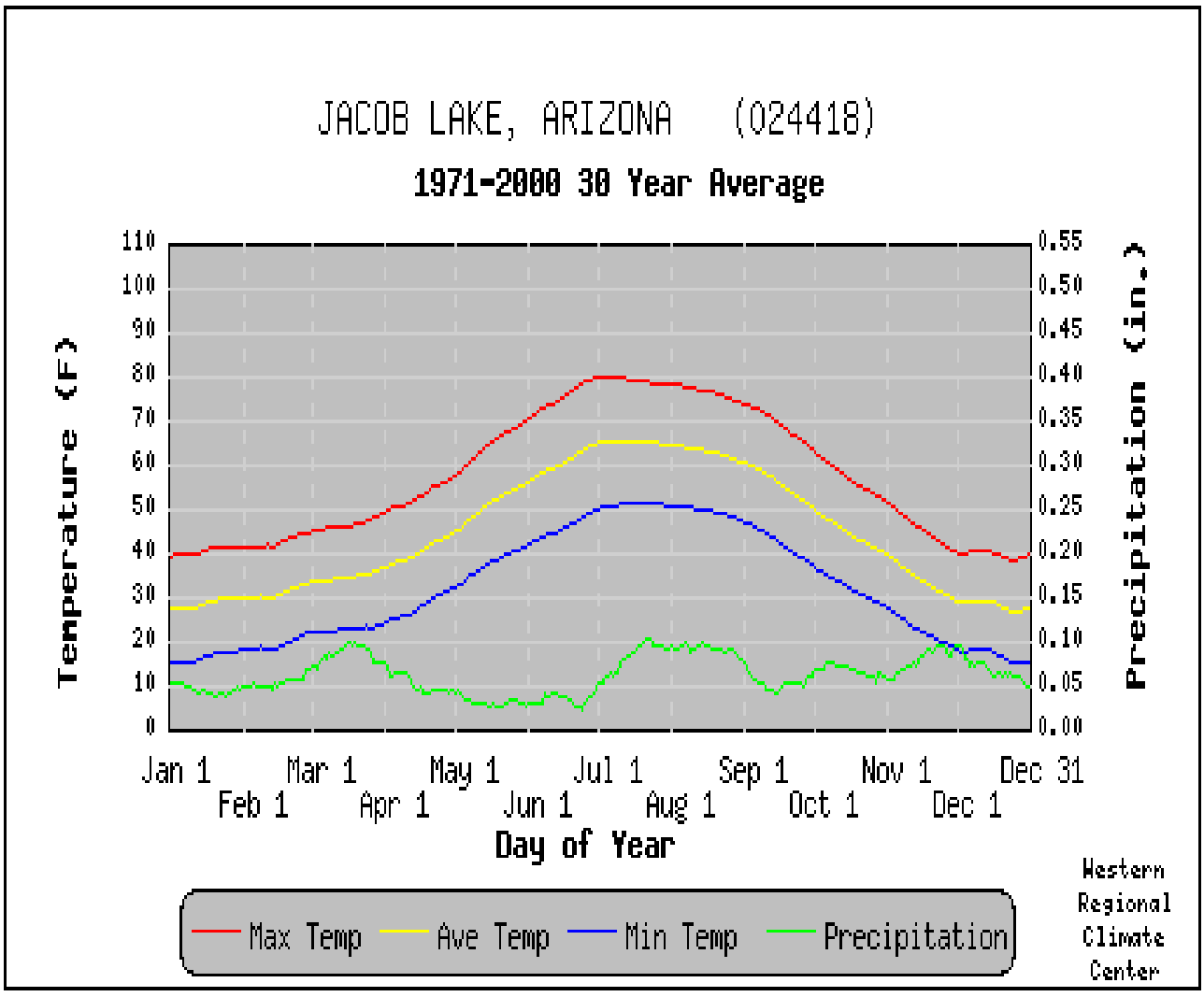
Wilderness: Federal land retaining its primeval character and influence without permanent improvements or human habitation as defined under the 1964 Wilderness Act. It is protected and managed so as to preserve the natural conditions, which (1) generally appear to have been affected primarily by forces of nature with the imprint of man’s activity substantially absent; (2) has outstanding opportunities for solitude or a primitive and confined type of recreation; (3) has at least 5,000 acres, or is of sufficient size to make practical its preservation, enjoyment, and use in an unimpaired condition, and (4) may contain features of scientific, educational, scenic, or historical value as well as ecologic and geologic interest.

Wildland Fire Use: The management of naturally ignited wildland fires to accomplish specific resource management objectives in predefined geographic areas.

APPENDIX C: Temperature and Precipitation

Climatologic Conditions

The graph below and the table on the following page depict annual temperature and precipitation trends at Jacob Lake, Arizona. The data was obtained on the internet from the Western Regional Climate Center. http://www.wrcc.dri.edu/climsum.html



Annual temperature and precipitation trends at Jacob Lake, Arizona

Period of record for a general climate and precipitation summary

Station:(024418) JACOB LAKE														
From Year=1950 To Year=1987														
	Precipitation											Total Snowfall		
	Mean	High	Year	Low	Year	1 Day Max.		≥ 0.01 in.	≥ 0.10 in.	≥ 0.50 in.	≥ 1.00 in.	Mean	High	Year
	In.	in.	-	in.	-	in.	dd/yyyy or yyyymmdd	# Days	# Days	# Days	# Days	in.	in.	-
January	1.43	4.01	82	0.00	72	1.25	04/1973	5	4	1	0	15.2	54.0	82
February	1.22	3.08	69	0.00	57	1.00	08/1966	5	4	1	0	14.9	43.0	69
March	2.56	7.09	73	0.00	56	1.77	23/1962	7	6	2	1	27.7	100.9	73
April	1.49	3.81	64	0.00	57	1.36	02/1964	5	4	1	0	11.6	43.7	65
May	1.19	3.96	57	0.16	70	1.55	13/1965	5	3	1	0	3.3	18.0	65
June	0.78	4.89	72	0.00	57	2.50	22/1972	3	2	0	0	0.0	0.0	51
July	2.70	7.42	84	0.30	62	3.20	09/1975	9	6	2	0	0.0	0.0	50
August	2.69	5.58	71	0.21	74	2.00	19/1984	9	7	2	0	0.0	0.0	50
September	1.30	3.35	82	0.00	55	1.60	07/1950	5	3	1	0	0.1	3.0	86
October	1.61	8.44	72	0.00	50	1.80	20/1972	5	4	1	0	2.9	14.0	71
November	1.73	5.23	85	0.00	56	1.60	29/1975	4	3	1	1	14.0	52.8	85
December	1.98	7.25	66	0.00	57	1.88	08/1960	6	4	1	0	15.6	51.5	84
Annual	20.69	31.91	82	5.91	56	3.20	19750709	69	49	12	4	105.4	177.5	82
Winter	4.63	8.57	67	1.43	64	1.88	19601208	16	12	2	1	45.8	109.6	85
Spring	5.24	10.02	73	1.18	56	1.77	19620323	18	12	3	1	42.6	129.4	73
Summer	6.17	14.45	84	2.67	76	3.20	19750709	22	15	4	1	0.0	0.0	51
Fall	4.64	13.08	72	0.00	56	1.80	19721020	14	10	3	1	17.1	53.1	85

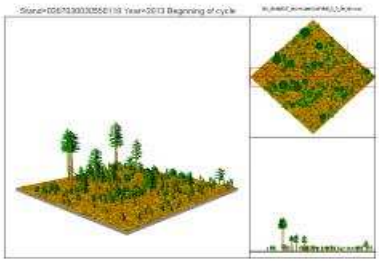
Table updated on Dec 5, 2003. For monthly and annual means, thresholds, and sums: Months with 5 or more missing days are not considered. Years with 1 or more missing months are not considered. Seasons are climatological not calendar seasons

Winter = Dec., Jan., & Feb.	Spring = Mar., Apr., & May	Summer = Jun., Jul., & Aug.	Fall = Sep., Oct., & Nov.

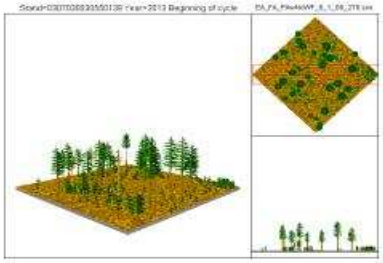
Western Regional Climate Center, mailto:wrcc@dri.edu

APPENDIX D: Special Wildlife Figures

Figure 1: Even-aged Stands 2013



Alternative 1 – No Action



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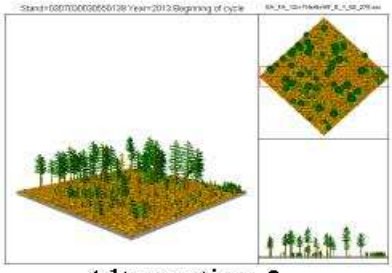

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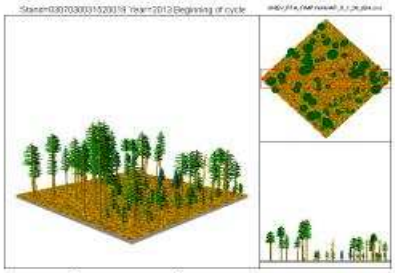
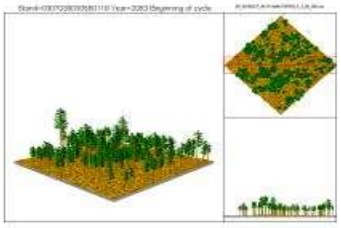
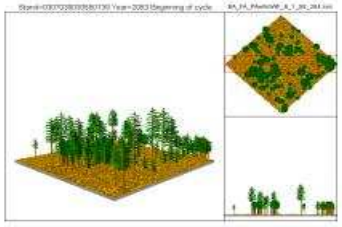


Alternative 4

Figure 2: Even-aged Stands 2053



Alternative 1- No Action



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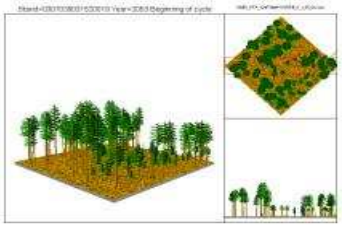

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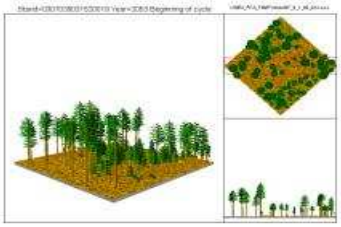
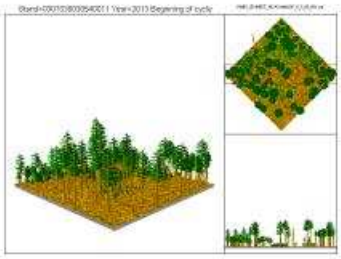
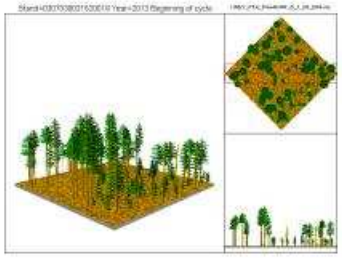


Alternative 4

Figure 3: Uneven-aged Stands 2013



Alternative 1 – No Action



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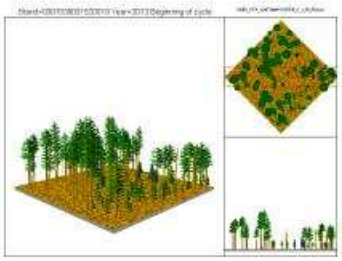

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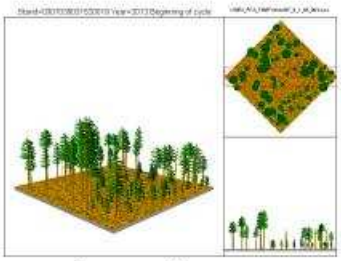
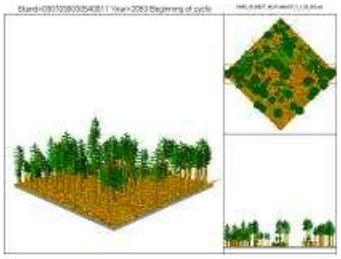


Alternative 4

Figure 4: Uneven-aged Stands 2053



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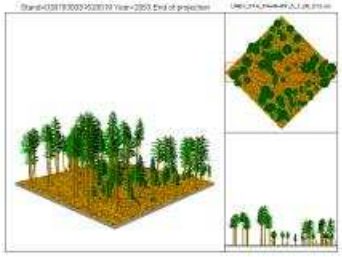

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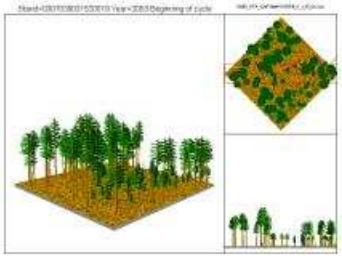
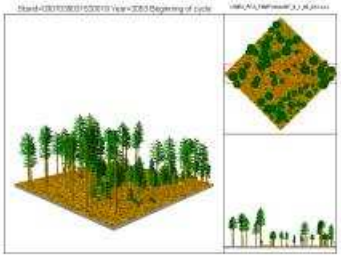


Alternative 3



Alternative 4

APPENDIX E: Cumulative Effects Table

Past, present, and foreseeable future actions in the analysis area vicinity

Project Type	Total Acres	Brief Project Description	Implementation Date or Status
Multiple timber and salvage sales	34,000	Multiple timber sales using various types of vegetation management strategies that included individual tree selection, shelterwood cut, seed-tree cut and sanitation salvage provided the existing harvest condition for the project area.	Past: 1970s—1990 Direct and indirect effects usually stabilized by time and vegetation
Salvage	2,100	Willis blowdown and fire salvage treatment and reforestation adjacent to the Jacob-Ryan project area.	Past: 1987 effects usually stabilized by time and vegetation
Wildfire	464	Hidden Fire salvage in analysis area. Snag retention maintained on steep slopes	Recent Past: 2001 effects starting to stabilized by time and vegetation
Prescribed fire	1,500	A few prescribed burns including Jack Jolly and others adjacent to the Jacob-Ryan project area that were treated mechanically and prescribe burned. Some were over burned by the Warm Fire.	Recent Past: 2005 Vegetation treatments destroyed by the Warm Fire.
Wildland Fire Use converted to Wildfire suppression	59,000	Warm Fire burned about 20 K acres as fire use and 39K acres under fire suppression. Loss of vegetation, soil impacts, loss of wildlife habitat and species.	Recent Past: 2006 Early seral vegetation in place
Hazard tree removal	300	ADOT removal of hazard and burnt trees along Highways 67 and 89A following the Warm Fire. Highway corridor experiencing a great deal of aspen regeneration.	Recent Past: 2007 Some pile burning remains to complete.
Reforestation	1600	Plant ponderosa pine and Douglas fir seedlings within severely burned acres of the Warm Fire. Planting occurred in areas deficit of viable seed trees.	Recent Past: 2008
Grazing	26,000	Grazing is ongoing on the Forest as an acceptable multiple use. Use is monitored and adjusted as needed to conform to range desired conditions	Past, Present and foreseeable: Ongoing
Hazard tree removal	2,000	Hazard tree removal along Forest Service roads and trails for public safety following the Warm Fire.	Present: Ongoing About ½ completed.
Westside wildlife habitat improvement	18,000	Westside habitat improvement project to improve mule deer range. Involves pinyon-juniper thinning, seeding and cliffrose enhancement.	Present: Ongoing Only a small amount of acreage adjacent to project area.

Past: Greater than 10 years, Recent Past: Less than 10 years, Present: Existing or ongoing, Foreseeable or future activities: Within 5 years.

Past, present, and foreseeable future actions in the analysis area vicinity

Project Type	Total Acres	Brief Project Description	Implementation Date or Status
Invasive plant species	NKRD All	Invasive species monitoring and treatment especially cheat grass. Roadside treatments and post fire treatments treated immediately as identified. Areas mechanically treated are rested and monitored for cheat grass and delayed mortality. These areas treated prior to any prescribed burning activities	Present: Ongoing Continuous monitoring and treatment.
Facility expansion	58	Replace existing and add new Jacob Lake facilities. Project restricted to existing impact area.	Present: Ongoing Multi-year project
Research studies	~400	Multiple transects established pre and post Warm Fire to observe vegetation response, seedling survival, impacts on soils, erosion and wildlife habitat.	Present: Ongoing
Communications site	Less than 5	Aircell communication site development with a new equipment building and antennas on existing tower. At an existing hardened site. No ground disturbing activities.	Present: Ongoing Only limited activity and noise associated with site development
Salvage and Reforestation	9,000	Warm Fire Recovery Project proposes to salvage and reforest a portion of moderate and high severity burned acres to assist and protect the natural recovery of the burn area.	Future: Proposed Action under review. Possible implementation in 2009.
Vegetation Management	26,000	Move Jacob-Ryan project area towards a short interval fire-adapted landscape by converting even-aged stands to uneven-aged and enhancing stands currently managed as uneven-aged. This would follow goshawk and visual quality guidelines.	Future: Proposed Action under review. Possible implementation in 2009
Wildlife habitat improvement	2,000	The Fracas wildlife habitat improvement project to thin ponderosa pine for goshawk and their prey habitat and enhance deer habitat.	Future: Proposed Action approved with possible implementation in 2008.
Wildlife habitat improvement	1,000	Ryan free firewood cutting area to be followed by burning and planting to improve wildlife forage.	Present: Ongoing Multiple year and impacts snag retention by public cutting.
Travel management	NKRD all	Designate a mapped motorized road system for the North Kaibab Ranger District. Project could involve closure of some roads causing resource damage or are parallel roads with a same destination.	Future: Project to start during the fall of 2008 and be completed during the fall of 2010.
Wildland-Urban Interface Fuels Reduction	~3,500	North Kaibab Plateau WUI Fuels reduction project collaboratively designed to protect multiple stakeholders and their property from wildfires	Future: Project to start during the fall of 2008 and be completed during the fall of 2009.

Past: Greater than 10 years, Recent Past: Less than 10 years, Present: Existing or ongoing, Foreseeable or future activities: Within 5 years.

APPENDIX F: Forest Plan vs. Mass Model for Old Growth

Objective: Explain the rationale used by the NKRD to use the Kaibab NF Land Management Plan ROD (Record of Decision) for Old-Growth determination in the Jacob-Ryan project versus the MASS model.

As the Forest Service, we are mandated by law to follow the Forest Plan for implementation of management projects until a new plan is adopted. The Old-Growth characteristics are described on pages 32 -34 of the Kaibab NF Land Management Plan amended 6/96; the plan that we currently follow. The table on page 34 is specific as to required characteristics of Old-Growth, notably in the number of large trees by species in defined forest types. For example, ponderosa pine would have at least 20 trees per acre 18" DBH or greater, over 180 years old, to meet this requirement for high value Old-Growth. Basal area, canopy cover, snags, and downed woody debris are also key features described.

The MASS model was a collaborative effort between the Forest Service, Arizona environmental groups, Arizona Game and Fish, Northern Arizona University, and forest industry representatives to develop an improved definition of Old-Growth. This model breaks down the ecological succession of ponderosa pine into five phases. The first phase is commonly the aftermath of catastrophic fire. The remaining phases transition from blackjack trees to a combination of blackjacks and yellow pines to the last phase which represent a decaying period when tree death and decay peaks.

My professional experience for ponderosa pine in the southwest, especially on the Kaibab Plateau, is that disturbance in the form of fire is frequent and catastrophic, and disease is widespread. Catastrophic fire has destroyed over 120,000 acres on the North Kaibab RD in the past twelve years. The mistletoe infection centers on the north end of the forest were so extensive during the 1980's that sanitation treatments were basically clearcut and plant methods. Those areas are now even-aged plantations.

Climax conditions described in Phase 4 are decay, death, self-thinning, and large amounts of downed, woody debris. I have not seen Phase 4 on the North Kaibab except for very moist sites that burn infrequently, similar to white fir or subalpine fir climax forest types. Fire is so frequent in the ponderosa pine forest type that crown and surface fires remove a large component of surface material, and burn snags as well. The greatest opportunity may be in the fir forest types where the district would need to aggressively implement mechanical treatment and fire to maintain seral ponderosa pine in moist environments. Currently, under Mexican Spotted Owl guidelines, we would not be able to reduce basal area to 20-60 as required in Phase 4 of the MASS model. Also, these moist forest types are not in the JR project area.

Garry Domis – District Silviculturist

APPENDIX G: Response to Scoping Comments

Issue Categories: A=Potpourri, B=Mechanical Rx, C=Fuels/Prescribed Burn, D=Wildlife, E=Old Growth, F=Watershed/Soil, G=Roads/Trail, H=Forest Health, I=TES, J=Forest Plan, K=Recreation/Visual, L=Aquatics, M=Vegetation, N=Cumulative Effects, O=Alternatives, P=Stand/guides/mitigation, Q=grazing

Letter #	Commenter	Issue Category
1	Erik B. Ryberg (CBD), 445 W. Simpson St., Tucson, AZ 85701	**A, B, D, E**
2	David Darger, PO Box 70, Colorado City, AZ 86021 (Mayor)	**B, K**
3	Andi Rogers, (AGFD) 3500 S. Lake Mary Rd., Flagstaff, AZ 86001	**D, J, M**
4	Sharon Galbreath, (Sierra Club), 8655 N. Roundtree Rd., Flagstaff, AZ 86001	**A, B, D, E F, H, J, M, O**
5	Taylor McKinnon, (CBD), PO Box 1178, Flagstaff, AZ 86002-1178	**A, B, C, D, E, G, M, N, O, Q**

Environmental Coordinator
Category A
Comment 1: Should be doing an EIS instead of an EA, Category A, letter #1.
Response: This is not a significant issue as it does not present any substantive effects.

Comment 2: Why change the analysis process as previous process was an EIS, Category A, letter#4.
Response: This is an entirely new project with an old name. It deals solely with one community type with the goal of attaining a fire adapted landscape.

Comment 3: Should be doing and EIS instead of an EA, Category A, letter #5.
Response: This is not a significant issue as it does not present any substantive effects.

Comment 4: Must evaluate and analyze issues on prior JR iterations, Category A, letter #5.
Response: All issues from prior projects that pertain to this singular project will be considered and evaluated. The issues from previous JR projects that are now outside the scope of the current project will be removed from detailed analysis.

Category D
Comment 9: Need to evaluate and analyze the effects on the Grand Canyon Game Preserve, Category D, letter #5.

Response: This is a standard part of the wildlife specialists report and is included because of its special protections for propagations of wildlife game animals, their habitats and prey.

Category N

Comment 1: Identify and analyze all cumulative effects for the JR project, Category N, letter #5.
Response: This is a standard part of all specialist reports and would be incorporated into the combined environmental analysis. All direct and indirect effects presented in specialists reports would evaluated for past, present and foreseeable future effects on the project area and the analysis area.

District Silviculturist

Category B

Comment 1: Wants a mandated 16" cutting cap for PP.

Response: We analyzed selected stands with the 16" cap, and determined that splitting the VSS 4 class would not be advantageous for achieving desired conditions.

Comment 2: Commercial harvesting for Veg. Treatment?

Response: Yes; in the Proposed Action (PA), we would have a commercial harvest of trees up to 18" DBH.

Comment 3: Size cap for harvesting should be less than 18".
Response: We analyzed an alternative with a 12" DBH harvesting limit.

Comment 4: Trees per acre vs. canopy cover.

Response: Canopy cover and trees per acre were modeled with KNF I&I and Forest Plan guidelines or plot basis is appropriate in uneven-aged stands. In even-aged stands, the canopy cover applies to the entire stand area.

Comment 5: Impacts from previous harvests (even aged).

Response: The even-aged stands were also modeled w/guidelines to maintain goshawk habitat and prey base. These stands would be moved into uneven-aged condition over time.

Comment 6: 12", 14", 16", 18"

Response: We analyzed diameter limits at 12", and 18" DBH; these represent VSS class break diameters. We also ran the model at 16" DBH for selected stands as a sample for this limit.

Comment 7: Structural stand objectives.
Response: The range of alternatives would include stand objectives related to structure, namely the progression of stands across the landscape to uneven-aged, fire-adapted conditions.

Comment 8: Use eri pre-settlement model.
Response: Outside scope of this document.

Category E

Comment 1: Old growth loss due to Warm Fire
Response: The effects of the Warm Fire regarding VSS distribution post-fire, especially acres in VSS 6, was addressed in the Cumulative Effects section of the Vegetation report.

Comment 2: What determines old growth?
Response: The Kaibab NF Forest Plan has specific requirements for old growth on the stand basis.

Comment 3: Logging Old growth.
Response: No trees over 18" dbh to cut; trees with old tree characteristics (established before settlement; flat tops; wide, plated bark) would also be retained.

Comment 4: Logging old growth at what diameter cap?
Response: The proposed action would leave 18" and larger trees. Some trees less than 18" with old tree characteristics, especially flat-tops, would also be left.

Comment 5: Use of the MASS model.
Response: The Kaibab NF Forest Plan model and guidelines would be used for old growth.

Comment 6: What to keep intact as old growth forest.
Response: Yellow pine characteristics would be used to determine what is old. An excellent publication on old trees and their characteristics is "Identification and Ecology of Old Ponderosa Pine Trees in the Colorado Front Range", by Huckaby et al 2003. For trees over 200 years old, considered "old trees", the crown shape is flattened, with a "bonsai" appearance, sparse, open, and may be lopsided. According to Huckaby et al, the bark on old trees has no fissures.

Category G
Comment 3: Use of existing roads.
Response: There are enough roads to access the project area for implementation. The commercial harvest units would need a layout of the skid trail system.

Category H
Comment I : Impacts for habitat and wildlife post Warm Fire
Response: There is a need to move the Jacob-Ryan project area toward resilience to natural disturbance like wildfire with commercial and non-commercial thinning. By restoring fire adapted systems in the project area, we would be able to allow fire to play its natural role: frequent (fire intervals of 2-12 years), low intensity surface fires that maintain an open ponderosa pine forest.

Category 3
Comment 1: Canopy cover reduction/Forest Plan/Interpretation
Response: With the KNF I& I guidelines, and direction from the Forest Plan, we would manage mid-aged to old-aged groups of trees at 40-70% canopy cover. Canopy density is more accurately measured for plots, but our current system uses point data and then calculates stand canopy cover. In stands, it is difficult to achieve 40-70% canopy cover given the open nature of ponderosa pine sites. Within groups of trees in the VSS 4-6 classes with the 18" diameter limit, canopy cover should not be a limiting factor during this initial entry or treatment.

Comment 2: Interpretation of MRNG for implementation.
Response: Management guidelines for the northern goshawk were developed using the research and guidance provided in RM-217 by Reynolds et al. The Kaibab NF used this report to develop the Interpretation and Implementation guides which were used for modeling and analysis work in the JR document.

Category M
Comment 1: Canopy cover in stand vs. grp. Level
Response: This was discussed above. As we move toward uneven-aged stands across the landscape, we would measure canopy cover at the group level, and target 60% of the acres in VSS 4-6. We should meet canopy cover targets of 40-70% in these groups.

Comment 2: Fragmentation of forest canopy.
Response: Fragmentation is a natural process in ponderosa pine systems by disturbance agents like fire, drought, and tree mortality due to insects and disease. Silvicultural systems mimic nature, and are designed to ensure or promote regeneration, both natural and planted. We would design JR treatments to avoid stand replacing wildfires like the Warm and Hidden fires. Those events removed the entire canopy in the severely burned areas, and moved the landscape toward even-aged condition, or the potential for type conversion to brush, grass, or meadow.

Comment 3: Trees per acre rather than canopy objectives.
Response: The trees per acre target by VSS class approximate natural, desired conditions in southwestern ponderosa pine stands. Canopy cover objectives would be met with sustaining the target trees per acre in trees greater than 18" DBH.

Comment 4: Impacts of even-aged mgmt.
Response: Move stands toward uneven-aged condition in areas that were established under past seed/shelterwood harvests. Many of these stands are now in a two-storied condition, and would be moved toward uneven-aged with the conversion and harvest of groups of VSS 2 --- 3. By regenerating some acres to VSS 1, and opening the stand to grow VSS 3 into 4, over time we would stagger the age and size classes to create uneven-aged clusters and groups.

Comment 6: Large tree mortality post treatment.

Response: There would continue to be a risk for wildfire, insect mortality, and disease that could cause mortality in large trees after mechanical treatments. Western pine beetle prefers large ponderosa pine, and we have ongoing mortality of 18" plus trees due to dwarf-mistletoe. The drought has predisposed many large trees to mortality. By thinning from below, and improving vigor for residual large trees, we would be able to mitigate some of the effects of fire, insects, and disease. With prescribed fire under moderate conditions in JR, fire-resistant large pine trees should survive and thrive when dense understory trees are killed.

Comment 7: 12", 14", 16" & 18" harvest caps.
Response: See discussion above related to diameter limits.

Comment 8: Retain all trees regardless of size based on age or germinated prior to fire controls.

Response: We would address this by leaving trees with old age characteristics that were established prior to settlement.

Comment 9: Structural stand objectives.
Response: This comment was discussed above.

Wildlife

Category D
Comment 1: Need to provide goshawk population data upfront, Category D, letter #1.
Response: Goshawk population data is provided in the Biological Evaluation and Specialist Report and population trend data is referenced from the Forest Service Management Indicator Species of the Kaibab National Forest: Population Status and Trends. Version 2.0.

Comment 2: Interpretation of goshawk guidelines, Category D, letter#3.
Response: Management guidelines for the northern goshawk were developed using the research and guidance provided in RM-217 by Reynolds et al. The Kaibab NF used this report to develop the Implementation and Interpretation of Management Recommendations for the Northern Goshawk, Version 2.1, December 2005.

Comment 3: Habitat requirements vs. canopy cover, Category D, letter #3.
Response: The Kaibab NF Forest Plan guidelines and the accepted Implementation and Interpretation of Management Recommendations for the Northern Goshawk, Version 2.1, December 2005 will be used to determine canopy cover.

Comment 4: Implementation of MRNG, Category D, letter #4. Response: The current direction is to implement the Forest Plan.

Comment 5: Habitat changes & population dynamics vs. warm fire, Category D, letter #4.
Response: There is a need to move the Jacob-Ryan project area toward resilience to natural disturbance like the Warm Fire.

Comment 6: Source population for NOGO and Kaibab squirrel, Category D, letter #5.
Response: Statement does not need response.

Comment 7: Canopy dependent species, Category D, letter #5.
Response: The Kaibab NF Forest Plan guidelines and the accepted Implementation and Interpretation of Management Recommendations for the Northern Goshawk, Version 2.1, December 2005 will be used to determine canopy cover.

Comment 8: Project area vs. important W/L or protected habitat, Category D, letter #5.
Response: The project area does not have any identified important wildlife habitat/protected habitat designations.

Comment 9: Grand Canyon Game Preserve, Category D, letter #5.
Response: The Biological Evaluation and Specialist Report discusses the Grand Canyon Game

Preserve.

Comment 10: NOGO mandatory standards, Category D, letter #5.
Response: NKRD follows the KNF Plan guidelines for NOGO.

Comment 11: Population trends and MIS, Category D, letter #5.
Response: Population data is provided in the Biological Evaluation and Specialist Report and population trend data is referenced from the Forest Service Management Indicator Species of the Kaibab National Forest: Population Status and Trends. Version 2.0.

Comment 12: Downed logs, Category D, letter #5.
Response: The Kaibab NF Forest Plan guidelines will be used to determine number of downed logs and other woody debris.

Category H
Comment 1: Impacts for habitat and wildlife post Warm Fire, Category H, letter #4.
Response: The cumulative effects analysis includes impacts from Warm Fire.

Category I
Comment 1: MSO habitat, Category I, letter #5.
Response: Project area will not occur in MSO habitat.

Comment 2: NOGO habitat, Category I, letter #5.

Response: The Biological Evaluation and Specialist Report discusses NOGO habitat under Sensitive Species, MIS and Migratory Bird sections.

Comment 3: Kaibab Squirrel, Category I, letter #5.

Response: The Biological Evaluation and Specialist Report discusses Kaibab Squirrel under the MIS and Grand Canyon Game Preserve sections.

Fire and Fuels

Category C
Comment 1: Prescribed fire as a management tool (Plan).
Response: As addressed in the Fire and Fuels Specialist report, prescribed burning within ponderosa pine stands will be used as both a management action and as a restoration action for fire dependent ecosystems. Prescribed burning alone could cause a higher mortality then is desired for some treatment stands within Jacob-Ryan analysis area and within these even-aged, high density canopy stands, thinning will need to occur prior to the implementation of prescribed burning.

Comment 2: Tree mortality post prescribed burn.
Response: Tree mortality caused by prescribed burning was included when the FVS-FN'E runs were simulated to include post burn mortality in conjunction with mechanical management actions. This will ensure that prescribed burning does not create more mortality then is desired. Tree mortality is inevitable when implementing prescribed burns and utilizing best management practices such as developing a prescription that includes specific weather/fuels conditions that will retain as much of the existing stand as possible.

Comment 3: Defer livestock grazing post prescribed fire
Response: Adequate resting of prescribed burn areas that are located within existing grazing allotments will be given, pre/post implementation.
Comment 4: Previous reports might have been faulty, but we have new issues and new numbers, display effects better.
Response: Models used to predict the potential effects of fire will help guide managers decisions, however this project is located within a fire dependent ecosystem and the best available science related to this ecosystem will be evaluated to help determine implementation actions.

Comment 5: WFU as management tool.
Response: Although Wildland Fire Use for Resource Benefit is allowed within the project area, it is not within the scope of this project to implement or influence wildland fire use decisions.

Category M
Comment 6: Large tree mortality post treatment.
Response: Post treatment large tree mortality has been modeled. It is inevitable that some mortality from prescribed burning will occur however best management practices will be utilized to ensure that mortality rates fall within the desired results.

Category Q
Comment 1: Defer livestock grazing post prescribed fire.
Response: Adequate rest will be given to prescribed fire burn units located within existing grazing allotments that are in the project area for both pre and post implementation time periods.

APPENDIX H: Best Management Practices

This appendix includes design criteria, best management practices by resource, watershed conservation practices and relevant Forest Plan standards and guidelines.

Silviculture

- Old tree retention: Those ponderosa pine trees exhibiting mature or old-growth characteristics that indicate that they are more than 130 years old (mosaic yellow or yellowing bark and a flat crown, etc) would not be cut regardless of tree diameter**.**
- Interlocking canopy structure: Maintaining existing canopy structure during the creation or restructuring of clumps and groups of trees within stands to protect resident wildlife habitat.

Range

Each protocol on this list is formed from the 2005 Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds for the Coconino, Kaibab, and Prescott National Forests; Appendix B-Design Features, Best Management Practices, and Required Protection Measures.

- Conducting a pre-treatment inventory inside the project area. Areas to be inventoried will be prioritized in chronological order of anticipated activity timing before the project implementation begins. Areas likely to receive higher traffic like staging areas and along roads will be monitored first and random sampling of areas planned for treatment will follow in a timely manner. Areas where high infestations of aggressive invasive species are found, planned activities in that area will be delayed until the species is controlled.
- Prioritizing treatment of invasive species found during inventory. Invasive species found during inventory will be lumped together with current known infestations and treated using the most efficient means possible and in accordance with the Coconino, Kaibab, and Prescott EIS for Noxious and Invasive Weeds (2005). Once the invasive species is controlled, planned activity can begin.
- Continuation of monitoring during treatment. During project activity treatments, monitoring will be ongoing for additional species undetected during initial inventory and ensuring compliance. In the event that a new population is detected, the activity that site will be stopped until invasive species is controlled.
- Minimize soil disturbance to the extent practical, consistent with project objectives. This includes the design and need of slash piles, utilizing existing roads where applicable to decrease the need for new skid trails and fire lines.
- Washing equipment and vehicles related to activities prior to entering project area. Contracting officer will be responsible for ensuring this occurs on all equipment tied to a contract. The district will also require this policy for any vehicles and equipment used on project that came from off the district. Equipment and vehicles will also be washed before leaving the district at a pre-determined “clean location”.

- Ensuring weed free gravel and other materials sources. Providers of gravel and other materials used will have the source of material inspected prior to importing into the project area. If deemed necessary, material will be staged at pre-determined location for additional monitoring.
- Optimize pre-scribed burning for appropriate timing. Burning will be conducted during seasons of the year that promotes lower fire intensities and hinders possible weed infestation. Burning in dry years will also be avoided for improved native plant response.
- Utilizing Certified Weed Free Seed Sources. In the event that an area needs to be seeded post treatment, seed purchased will be from a reputable dealer that can provide official weed free certification for each species utilized. Seed mix will consist only of native species and/or certified sterile annuals and require approval of District Range Conservationist or Forest Botanist. In the event that local seed harvesting is available and certified as "weed free", that source will be utilized.
- Monitor after restoration treatment activity is completed. Random sampling will occur in areas that have been treated for at least two years after completion to monitor for invasive species that may have been introduced or spread.

Soil and Watershed

Application of BMPs will ensure compliance with the requirements of the Federal Water Pollution Control Act (Soil and Water Conservation Handbook (2509.22) and in agreement with the State of Arizona, Department of Environmental Quality.

- Use of TES Map in Timber Sale Design - Cutting units are designed in a manner that minimizes soil disturbances and facilitates BMP implementation. Obtain a TES map for location of site specific BMP's in specified TES map units.
- Use of Sale Area Maps for Designating Stream Courses for Water Quality Protection – Locations of designated stream courses and/or drainages, will be shown on the sale area map. Sink holes, meadows, springs seeps, and other surface waters (stock watering tanks) to be protected are also shown on sale area maps.
- Stream Course Protection – Stream course and/or drainages to be protected are shown on the sale area map. Best management practices buffer stream courses by 100 feet either side of the channel. Stream course and/or drainages are crossed perpendicularly only at designated crossings. Skidding and construction of temporary roads are not permitted within designated stream courses and/or drainages. Decking of logs, machine and hand piling of slash are not permitted within stream courses and/or drainages. Drainage features such as lead-out ditches, water bars, etc., are not constructed in such a manner that runoff is permitted to enter a designated stream course and/or drainage.

  Debris generated from timber harvest activities will be removed from designated stream courses and/or drainages. Trees that can be harvested from stream courses and/or drainages are those trees that have exposed root systems and are effective in providing stream bank stability. Trees are to be felled outside the stream course and/or drainages. Trees, that do not have exposed root systems and are provided stream bank stability, are not to be harvested. The timber sale administrator with their authority would locate skid trails and decking areas outside stream courses and/or drainages not shown on the sale area map.

- Tractor Skidding Design – Skid trails in all are designated in all TES map units with the exception of TES map unit 9. Skid trails are not permitted in TES map unit 9. Skid trail designation is done in conjunction with the timber sale purchaser. Designated skid trails in TES map units 294, 298, 620 and 624 should be located on the contour and follow topographical features due to slopes exceeding 15%. Trees are felled and end lined to the skid trail. Prevent long, straight skid trail that run up and down the slope. Skidding of logs is done with the butt end of the log suspended above the ground surface. Limit skidding to slopes 30% or less.

- Erosion Control of Skid Trails – All skid trails will be water barred, scarified and reseeded with a native grass species designed to control erosion. Depressions such as ruts and berms will be filled in or removed, restoring skid trails to the natural grade of the slope where possible. All skid trails will be covered with slash generated from timber harvest activities.

  In addition, skid trails located in TES map units 294, 298, 620, and 624 shall have water bars constructed by hand where excessive slope prevents improper water bar construction by machine (excessive ground disturbance, construction of tank traps, etc., is not acceptable).

- Log Landing or Decking Areas – Log landings or decking areas are not to be located in sink holes and meadows (TES map unit 9). No log landings or decking areas are permitted on slopes exceeding 15% (TES map units 294, 298, 620 and 624). Log landing or decking areas are permitted within these map units if the area is less than 15% slope, is large enough to facilitate a decking area and is accessible by an existing haul road.

- Log Landing Erosion Control and Prevention – Immediately after use, landings are to be scarified and reseeded with an erosion control seed mix. Reseed with native grass species. Cover the log landing or decking area with slash generated from timber harvest activities.

- Limit the Operating Season – Limit all ground disturbance mechanized activities (tractor skidding, decking, machine piling, etc.) to periods when soils are dry or frozen. The objective is to minimize soil compaction and displacement (rutting, etc). This applies to soils in all TES map units.

- Soil Loss at Tolerance – Maintain acceptable effective ground cover levels to prevent soil loss from exceeding tolerable soil loss limits. Table 3 in this report presents effective vegetative ground cover (expressed as a %) at tolerable soil loss levels. Permit light to moderate ground disturbances only in which vegetative ground cover is disturbed, but not displaced or removed. In those areas where severe disturbance has resulted in removal of vegetative ground cover, apply harvest slash or other erosion control measures to restore the disturbed area. This applies to all TES map units. BMP's D, E, F, and G apply to designated skid trails, decking areas or log landings. BMP's M, N, and O apply to roads.

- Coarse Woody Debris – To maintain or improve long-term soil productivity, manage towards a minimum of 5 to 10 tons/acre of coarse woody debris. Coarse woody debris is defined as material >3inches in diameter. Coarse woody debris should be scattered evenly across the soil surface and represent all age classes where possible. Non-merchantable or cull logs are to remain on site and not brought into landing or decking areas. In areas (TES map unit 293 in the Marble Watershed and TES map unit 620 in the Kanab Creek Watershed) where coarse woody debris is deficient, lop and scatter slash to meet this

guideline. Also, lob and scatter slash in TES map unit 9. This BMP does not apply to urban interface areas or fuel breaks.

- Machine Piling of Slash – Machine pile slash only at log landings or decking areas. Only pile slash that is generated from timber harvest activities. Minimize displacement of soil and rock. Piles should be free from displaced soil and rock. Machine pile when soils are frozen or dry. Machine piling of slash is not permitted in TES map unit 9. Immediately after burning, landings or decking areas are to be scarified and reseeded with an erosion control seed mix. Reseed with native grass species. Cover the landing area with unburned slash generated from the timber harvest activities.
- Hand Piling of Slash – Do not hand pile slash in designated stream courses or drainages, springs, seeps, or other designated protected areas. Only pile slash that is generated from pre-commercial thinning activities. Hand piling of slash is not permitted in TES map unit 9. Immediately after burning hand piles, burn scars are to be scarified and reseeded with an erosion control seed mix. Reseed with native grass species. Cover the burn scar with unburned slash generated from the pre-commercial thinning activities.
- Broadcast Burns – Conduct broadcast burns when moisture and temperature conditions are suitable for burning that reduces fuels without totally consuming forest duff and removing effective vegetative ground cover. Do not allow complete consumption of heavy concentrated fuels where the potential exist for heat to expose and damage soils. Maintain acceptable effective ground cover levels to prevent soil loss from exceeding tolerable soil loss limits. Table 3 in this report presents effective vegetative ground cover (expressed as a %) at tolerable soil loss levels. Reseed severely burned areas with a native grass species that effective in controlling erosion. Consider spreading unburned slash over severely burned reseeded areas. No broadcast burning is permitted in TES map unit 9 due to unsatisfactory soil conditions
- Road Maintenance – Existing and temporary roads are maintained throughout the life of the timber sale. Ensure that drainage structures (rolling dips, culverts, rock crossings, etc.) are functioning correctly. Lead out ditches are maintained in a manner that does not allow sediment laden runoff to enter stream courses and/or drainages. Road debris and spoil material as a result of road maintenance activities is not permitted to enter any stream courses and/or drainage. Roads are to receive maintenance prior to winter shut down of logging operations
- Traffic Control During Wet Periods – To prevent road damage, the use of existing and temporary roads is not permitted during wet periods. Restrictions are decided by the timber sale administrator.
- Temporary Road Closures – Temporary roads are lightly scarified and reseeded with native grasses species effective in controlling surface erosion. Road berms are removed and ruts are filled in. Drainage control structures are cleaned, maintained and are working effectively. If possible, camouflage the road entrance with slash and rock to disguise the road closure.
- Servicing and Refueling Equipment – During servicing and refueling of equipment, pollutants from logging and road maintenance equipment are not permitted to enter stream courses or drainages. Select servicing areas well away from surface waters, seeps, springs, stream courses and drainages. Construct berms around sites to contain spills. The

timber sale administrator will designate the location, size and allowable uses of service and refueling areas.

- Conduct Implementation and Effectiveness Monitoring – Refer to the soil and water monitoring plan.

Soil and Water Monitoring Plan

The intergovernmental agreement currently in effect between the Arizona Department of Environmental Quality and the USDA Forest Service, Southwestern Region requires implementation and effectiveness monitoring of Best Management Practices. The following monitoring schedule and methodology will meet this requirement.

- Phase 1 – During Timber Sale Activities

  The timber sale administrator will monitor the implementation of BMP's during timber harvesting activities. Notes taken by the timber sale administrator will be used to track any issues or problems with BMP implementation. The Forest Soil and Watershed Specialist will provide assistance as needed by the timber sale administrator to provide clarification of BMP's specified in the Environmental Assessment.

- Phase 2 – Timber Sale Closure

  The timber sale administrator will verify that the timber sale purchaser has implemented all erosion control measures prior to the closure of the timber sale. Primary responsibility will be that of the timber sale administrator with assistance from the Forest Soil and Watershed Specialist if needed.

- C. Phase 3 – Broadcast and Pile Burning

  The District Fire Management Officer will verify that all erosion control measures associated with all burning activities has been implemented. The Forest Soil and Watershed Specialist will be provided assistance, if needed.

- Phase 4 – Effectiveness Monitoring

  Within the first 5 years following timber sale closure, BMP's are evaluated for effectiveness. Monitoring will concentrate on such items as erosion control measures for skid trails, log landing or decking areas, road maintenance and burned areas. Conduct a soil condition evaluation within cutting units. Focus on such items as vegetative ground cover, coarse woody debris, erosion, soil compaction and displacement. All monitoring results are documented. Primary responsibility is with the District Ranger and the Forest Soil and Watershed Specialist.

- Phase 5 – Follow Up

  Documented information obtained from monitoring is used to adjust BMP's as necessary, to improve implementation and effectiveness of BMP's. Information regarding monitoring results and recommended changes to BMP's will be made available to the Arizona Department of Environmental Quality for review as specified in the Intergovernmental Agreement. Primary responsibility is with the District Ranger and the Forest Soil and Watershed Specialist

Archeology

- In order to protect heritage resource sites, all sites have been identified and documented using cultural resource survey standards as per the North Kaibab Survey Strategy (Reid and Hanson 2006). The sites will be flagged for avoidance prior to project implementation. The standard survey procedures are designed to identify and document sites visible on the surface of the ground, so in the event that an undocumented site is unearthed during ground disturbing activities, implementation activities will cease and the North Zone archaeologist will be contacted to assess the remains and complete any legal consultation required.
- All unevaluated heritage resource sites or sites eligible to the National Register of Historic Places will be avoided during the implementation of any ground disturbing activities. Prescribed burning will be permitted at non-fire sensitive sites. However, no piling of slash, pile burning or broadcast burning of slash will be authorized atop any sites.
- These design criteria will meet site protection standards in accordance with the provisions in the Programmatic Agreement for Compliance with Section 106 of the National Historic Preservation Act for Undertakings in Region 3, USDA Forest Service.

Fire and Fuels Activities

- A prescribed fire burn plan would be prepared for each unit utilizing the interagency prescribed fire burn plan template and in accordance with silvicultural and range management prescriptions
- Other than the burning of slash piles, or broadcast burning when there is no mechanical treatments, prescribed burning would not be implemented in the same year as mechanical treatments
- Mechanical units would be evaluated annually to ensure that follow up prescribed burning does not create more mortality then stated in silvicultural prescription
- A 2 year minimum rest/rotation will be given to areas that are burned within grazing allotment units and can be adjusted based on annual use and site monitoring
- 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
- All prescribed fire activity would be conducted consistent with wildlife time restrictions
- Ignite prescribed burns when fuel moistures are high enough to prevent frequent torching of larger trees
- Clear dead material away from the base of the trees to prevent torching or root damage
- Schedule burns that avoid weather conditions, which would impact smoke sensitive areas and create excessive smoke particulate emissions

Recreation and Visuals

- Mark trees on side facing away from road on trees found within 200 ft of the road edge. Do the same on trails found within 50 ft of the trail edge.
- If "leave" trees are marked, use butt mark only within 200 ft of the road and 50 ft of trail edges and mark on the side facing away from the road or trail.

- Sign trails/trailheads to advise of vegetative or prescribed burning treatments, schedule, closures.
- Make edges of meadow restoration treatments irregular. Feather in with lower tree densities so there are no abrupt changes that are noticeable.
- Keep stump heights low within 50 ft. of trail edges.
- Keep stump heights low in meadow restorations, and remove slash (pull back or burn).
- If sanitation cuts are used to reduce mistletoe, feather edges up to the treatment areas to avoid abrupt changes in tree densities.
- Do not construct skid trails perpendicular to roadways. Do not skid onto or up to Hwy. 89A or 67 (skid away from highway corridors).
- Rehabilitate skid trails, log decks, or other disturbed areas by restoring the original contours, fine grading, and seeding with native seed mix.
- Treat slash consecutively during commercial and non-commercial thinning.

Wildlife

Condor Conservation Measures

- Prior to the start of construction activities, the district will contact personnel monitoring California condor locations and movement on the district to determine the locations and status of condors in or near the project area.
- If non-nesting condors occur within one mile of the project area, actions will be reviewed for condor concerns, and possibly postponed until the condors leave or are hazed by permitted personnel.
- If condor nesting activity is known within one mile of the project area, then loud activities will be restricted during the active nesting season. The active nesting season is February 1- September 30. These dates may be modified based on the most current information regarding condor nesting and consultation with the district biologist (Angela Gatto @ 928 643 8127) and the Fish and Wildlife Service.
- If condor nesting activity is known within 0.5 mile of the project area, then light and heavy noise producing activities in the project area will be restricted during the active nesting season.
- If a condor occurs at a construction or other activity site, activities will cease in the immediate area until the condor leaves on its own or until techniques are employed by permitted personnel which results in the individual condor leaving the area (e.g. hazing).
- Construction workers and supervisors will be instructed to avoid interaction with condors and to immediately contact the appropriate district biologist or Peregrine Fund personnel if and when condor(s) occur at a construction site.
- The activity site will be cleaned up at the end of each day the work is being conducted (e.g., trash removed, scrap materials picked up) to minimize the likelihood of condors visiting the site. District staff will complete a site visit to the area to ensure adequate clean-up measures are taken.

- To prevent water contamination and potential poisoning of condors, a vehicle fluid-leakage and spill plan will be developed and implemented for each project utilizing vehicles larger than pickup trucks and fire engines/pumpers and water tenders (i.e. 18-wheelers and skidders). It will include provisions for immediate clean-up of any hazardous substance, and will define how each hazardous substance will be treated in case of leakage or spill. The plan will be reviewed by the district biologist to ensure condors are adequately addressed.
- If a new structure occurs on the rim or above tree line in other areas, there may be a need to install condor deterrent devices on the structure. This possible need will be evaluated on a case-by-case basis by the district wildlife biologist.
- All helicopter dip tanks will be covered when not in use
- All fire personnel performing at the crew leader and higher level positions will be provided literature or be instructed regarding condor concerns.
- Any presence of condors in the project area will be recorded and reported immediately to the district or assistant biologist.
- If condors arrive at any area of human activity associated with permitted activities, the birds will be avoided. The district or assistant wildlife biologist will be notified, and permitted personnel will haze the birds from the area.
- No non-permitted personnel will haze condors.
- All camp areas will be kept free from trash.
- Aircraft use along the rim of the Grand Canyon will be minimized to the greatest extent possible.
- Aviation personnel will contact the Peregrine Fund daily (at 520-606-5155 or 520-380-4667) during wildland fire use operations involving aviation to check on locations of condors.
- If any fire retardant chemicals must be used, the application area will be surveyed and any contaminated carcasses will be removed before they become condor food sources unless safety concerns override this restriction.
- Aircraft will remain 437 yards (400 meters) from condors in the air or on the ground unless safety concerns override this restriction.
- If airborne condors approach aircraft, aircraft will give up airspace to the extent possible, as long as this action does not jeopardize safety.
- The district will adhere to the air quality standards set by the Arizona Department of Environmental Quality.
- Smoke from wildland fire use projects will be prevented from negatively affecting condor breeding. A given potential wildland fire use event will not be initiated, or an existing fire use event will be modified or terminated, in order to prevent or stop significant amounts of smoke, or smoke that will remain in place for an extended period of time, or chronic smoke events, from occurring in area(s) where condors are attempting to breed.

National Bald Eagle Management Guidelines

Recommendations for avoiding disturbance at foraging areas and communal roost sites

- Minimize potentially disruptive activities and development in the eagles' direct flight path between their nest and roost sites and important foraging areas.
- 2. Locate long-term and permanent water-dependent facilities, such as boat ramps and marinas, away from important eagle foraging areas.
- 3. Avoid recreational and commercial boating and fishing near critical eagle foraging areas during peak feeding times (usually early to mid-morning and late afternoon), except where eagles have demonstrated tolerance to such activity.
- 4. Do not use explosives within ½ mile (or within 1 mile in open areas) of communal roosts when eagles are congregating, without prior coordination with the U.S. Fish and Wildlife Service and your state wildlife agency.
- 5. Locate aircraft corridors no closer than 1,000 feet vertical or horizontal distance from communal roost sites.

Additional recommendations and management practices that landowner and planners can exercise to benefit bald eagles

- Protect and preserve potential roost and nest sites by retaining mature trees and old growth stands, particularly within ½ mile from water.
- Where nests are blown from trees during storms or are otherwise destroyed by the elements, continue to protect the site in the absence of the nest for up to three (3) complete breeding seasons. Many eagles will rebuild the nest and reoccupy the site.
- To avoid collisions, site wind turbines, communication towers, and high voltage transmission power lines away from nests, foraging areas, and communal roost sites.
- Employ industry-accepted best management practices to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles. If possible, bury utility lines in important eagle areas.
- Where bald eagles are likely to nest in human-made structures (e.g., cell phone towers) and such use could impede operation or maintenance of the structures or jeopardize the safety of the eagles, equip the structures with either (1) devices engineered to discourage bald eagles from building nests, or (2) nesting platforms that will safely accommodate bald eagle nests without interfering with structure performance.
- Immediately cover carcasses of euthanized animals at landfills to protect eagles from

being poisoned.

- Do not intentionally feed bald eagles. Artificially feeding bald eagles can disrupt their essential behavioral patterns and put them at increased risk from power lines, collision with windows and cars, and other mortality factors.
- Use pesticides, herbicides, fertilizers, and other chemicals only in accordance with Federal and state laws.
- Monitor and minimize dispersal of contaminants associated with hazardous waste sites (legal or illegal), permitted releases, and runoff from agricultural areas, especially within watersheds where eagles have shown poor reproduction or where bio-accumulating contaminants have been documented. These factors present a risk of contamination to eagles and their food sources.

Northern goshawks

- All established northern goshawk guidelines in RM 217 and the Kaibab National Forest Plan will be followed to protect the species, its habitat and its associated prey species.

Engineering and roads

- District engineer will establish a suitable road system to implement the vegetation management project.
- District engineer will open any closed roads for the project and re-close at project completion.

APPENDIX I - Response to Comments for the Environmental Assessment

Issue Categories: A=Potpourri, B=Mechanical Rx, C=Fuels/Prescribed Burn, D=Wildlife, E=Old Growth, F=Watershed/Soil, G=Roads/Trail, H=Forest Health, I=TES, J=Forest Plan, K=Recreation/Visual, L=Aquatics, M=Vegetation, N=Cumulative Effects, O=Alternatives, P=Stand/guides/mitigation, Q=grazing, R=Climate Change S=Economic & local economy, T=Invasive weed species

Letter #	Commenter	Issue Category
1	James L. Matson, 135 West Kanab Creek Dr., Kanab, UT 84741 (rural life foundation)	**O, S**
2	Andi Rogers,3500 S. Lake Mary Rd., Flagstaff, AZ 86001 (AGFD)	**D, J, M**
3	Eli Bernstein, 2601 North Fort Valley Road, Flagstaff, AZ 86001 (Grand Canyon Trust)	**B, C, E, J, M, N, O, P, R, S**
4	Jay Lininger, PO Box 1178, Flagstaff, AZ 86002 (Center for Biological Diversity)	**A, B, C, D, E, F, N, O, Q, R, S, T**
5	Sharon Galbreath, 8655 N. Roundtree Rd., Flagstaff, AZ 86001 (GC Sierra Club)	**Same as 4**

Commenters raised concerns in three major topic areas and asked for clarification on sections of the effects analyses. The topics are climate change, large tree mortality following treatments and canopy cover measurement. This document addresses those specific comments.

Integrated Responses

Climate Change

Comments: Drought associated with climate change predicted in SW region may negate old growth stimulation after thinning (Category R, Letter 3, Paragraph 3, Lines 1-3, page 2). Additionally, climate change may be relevant to post-treatment delayed mortality of large trees and cheatgrass invasion, fire model outputs and implications for wildlife habitats. (Category R, Letter3, Paragraph 4, Lines all, page 3)

Responses: The proposed action would reduce inter-tree competition making the remaining trees more resistant and resilient in a water limited environment, and reduce the risk of uncharacteristic fire. One of the predictions about climate change is that wildfires will become larger and more frequent at the landscape scale (Backer et al. 2004). By reducing tree density, the Jacob-Ryan (JR) project would make the project area more resilient to wildfire, thereby protecting wildlife habitat. The potential for climate change makes it more important to implement treatments like Jacob-Ryan, especially given that cheatgrass is of particular concern following high intensity fire events.

Although there has been drought across the southwest region in recent years, the North Kaibab Ranger District has not had the same moisture shortages according to the Keetch-Byram drought index (KBDI) and the Palmer Drought Index. The Kaibab Plateau received 20 to 22 inches of precipitation each year over the past two years, which is average on the forest. Drought indices are monitored seasonally to ensure that prescribed burning can occur without impacting vegetation

beyond the limits established in treatment objectives, silvicultural prescriptions and resource mitigation measures.

Thinning to the desired number of trees per acre by VSS class would help minimize the effects of drought by reducing between tree competition for available moisture, light, and nutrients. Stone et al. (1999) found that thinning that restores the pre-Euro-American stand structure improves the vigor of large pre-settlement ponderosa pines. Increased canopy growth and increased uptake of water, nitrogen, and carbon indicated improved tree vigor. Vigor increases resistance while densely stocked trees are susceptible to mountain pine beetle attack (Larsson et al. 1983). These results suggest that appropriate forest management can be used to maintain pre-settlement trees in the ponderosa pine forests of the Southwest. Vegetation management prescriptions would use Best Management Practices, design criteria, mitigation measures, and monitoring to apply the proposed actions on the ground (Appendix H).

Large Tree Mortality

Comments: Reintroduction of surface fire led to delayed tree mortality disproportionately affecting large P. pines. (Categories C&P, Letter 3, Paragraph 2, Lines 1 & 4, page 2) Prescribed fire treatments can damage tree roots and cause high levels of mortality among large trees and fire treatments may leave trees susceptible to delayed bark beetle infestation. (Category B, Letter 4, Paragraphs 1&2, Lines all, page 3) On Mt. Trumbell [sic], this study reported that large pines were approx. twice as likely to die in treated units as in control units. (Category M, Letter 3, Paragraph 2, Line 2, Page 2)

Responses: Prescribed burning would not be implemented in the same year as mechanical treatments to reduce or recognize post treatment mortality (EA, Appendix H, page 148). Phased implementation is part of the proposed action and includes post treatment monitoring that provides an opportunity to adjust prescriptions to account for unanticipated levels of mortality should they occur.

A prescribed fire burn plan would be prepared for each unit using the interagency treatment burn plan template. The burn plans specify acceptable ignition patterns and prescriptions and implementation guidelines to reduce fire intensity around large trees. Burn plans are reviewed and approved by the responsible line officer, wildlife biologist, archeologist and other district staff to ensure that resource objectives are met. The fire models incorporate mortality factors. Design criteria and Best Management Practices are included in the proposal to minimize tree mortality.

"Forest restoration treatments, including the reintroduction of a surface fire regime, are intended to decrease fire hazard and emulate historic ecosystem structure and function," (Fule et al. 2004). The Jacob Ryan project would re-introduce surface fire to ponderosa pine stands. Prior to burning, thinning is needed in many areas to reduce fuel loads and ladder fuels. In areas exceeding 15 tons per acre for slash generated from thinning activities would be piled and burned during times of significant moisture, usually during late fall, winter, or early spring when snow is present. Some pre-burn preparation would be done include pulling excess duff and activity slash away from tree drip lines and boles before igniting surface burns. Finally, burn conditions are checked with a test burn before a prescribed fire is initiated.

Most of the studies and observations reporting about high levels of post-fire mortality were from areas with basaltic soils not the limestone soils of the Kaibab Plateau. There are differences in soil composition and root depth between basaltic, lava soils, and limestone-derived soils on the North Kaibab. Studies from other areas with different soil types may overestimate large tree mortality. Trees on the North Kaibab have deeper root structures and are protected from surface fire. The Mount Trumbull study sites referred to by the commenter were on two edges of a large,

shallow-soiled lava flow where tree roots were at or close to the surface. The area had been fire free for 130 years and experienced severe drought in 1989, 1996, and 2000. Thinning and the removal of excess fuel loads were not done prior to burning the area sites. The study showed and the authors recommended thinning treatments for forests on lava soils before initiating prescribed burns (Fule et al. 2002).

The North Kaibab Ranger District has successfully completed multiple prescribed burns without a lot of unanticipated tree mortality. Project specific monitoring following each stage of implementation provides an opportunity to adjust prescriptions to account for unanticipated levels of mortality should they occur.

Bark beetle mortality is monitored by foresters annually. The North Kaibab Ranger District does not have a significant bark beetle presence at this time (PR 41) and past prescribed burns within the area has not resulted in accelerated bark beetle activity. Drought is a known major cause of tree stress and predisposes trees to insect attack. Breece did a study in Arizona between 2004 and 2006 after a significant drought that occurred during 2002. The study was done on the Kaibab NF near Kendrick Mtn. (Williams Ranger District) with different soils and climate regarding bark beetle attack after fire. However, studies from different areas and soil types may not be suitable for direct comparison. This research was done after a peak in western pine beetle and Ips activity (Breece et al 2008). Breece also cites McHugh et al (2003) regarding less mortality due to low incidence of western pine beetle and *Ips* activity after fire. There have been documented incidence of red turpentine beetle attacks, but they seldom kill the tree.

Canopy Cover Measurements

Comments: It is our understanding that this decision to reduce canopy cover at the group level is based on R3 guidance per clarification of northern goshawk guidelines within the 1996 Forest Plan amendment. Targeting for 40-70% canopy cover in clumps/groups, with no indication of how large or small the clumps/groups are, makes it difficult to envision forest cover overall. (Category J and M, Letter 2, Paragraph 4, page 1 and Paragraph 2, page 2) The JR project must observe Forest Plan standards for canopy closure in each VSS class at the prescribed spatial scale. See the Forest Plan at 30. The Implementation Guide (USDA 2007b) shifts implementation of canopy cover closure requirements from stand to group scale (Category M, Letter 4, Paragraph 2-6, Lines all, page 6 and Paragraph 2-7, Lines all, page 7).

Responses: The Forest did not use the 2007 Region 3 Implementation Guide during the Jacob-Ryan project development. The "implementation guidelines" referred to are the Kaibab NF Interpretation and Implementation guidelines (2005), which provide guidance for implementing the Kaibab Forest Plan. The Guideline**s** are for Ecosystem Management in Northern Goshawk Habitat that includes canopy cover in the mid-aged to old forest structural stages (VSS 4, VSS 5 and VSS 6(Forest Plan, page 30). Forest Plan guidelines recommend canopy cover from 40 percent to 70 percent in the mid-aged, mature and old forest areas (VSS 4 through VSS 6). Because many of the stands are uneven-aged, containing areas of VSS 1-3, it is rare that the canopy requirement would apply across an entire stand.

Clump and group sizes vary, but in general groups range from about one-quarter to four acres, and clumps are trees with interlocking crowns within groups. Post treatment monitoring following implementation is included as part of the proposed action. The staged implementation and monitoring offers stakeholders an additional opportunity to view and provide feedback regarding attainment of the desired conditions so that implementation may be adapted during the subsequent implementation blocks.

NEPA

Comment 1: Any decision to cut and remove large trees will necessitate the preparation of an EIS (Category A, Letter 4, Paragraph 3, Lines 2 and 3, Page 4)

Response: This project does not propose to remove any trees greater than 18 inches DBH or presettlement trees exhibiting old tree characteristics regardless of tree diameter. Removing mid-sized trees is not an irreversible impact. Trees are renewable resources; they reproduce and grow. The EA analyzed the direct, indirect and cumulative impacts of the Jacob-Ryan proposal and no significant effects were identified, therefore an EIS is not needed.

Comment 2: We question and do not support artificial diameter cutting limits (caps) that are bio-politically motivated. Full implementation of Vegetative Structural Stage (VSS) management is now the responsibility forest managers in the southwest. (Category O, Letter 1, Paragraph 2, Lines 1 & 3, page 1)

Response: We recognize that full implementation toward the desired VSS distribution is the most efficient way to attain the desired conditions outlined in the project area. We analyzed and evaluated a full implementation alternative for the Jacob-Ryan project, but did not select it. The Forest decided not to cut trees larger than 17.9 inches due to the deficits of mature and old trees in the greater analysis area.

Comment 3: The FS must set out to reduce unacceptable tree densities in conifer and aspen tree stands by using commercial tree removal, pre-commercial thinning in individual and group selection cuts and individual tree selection to maintain and increase variability in density, spacing and size classes……. (Category O, Letter 1, Paragraph 3, Line 7, page 2)

Response: We concur that a variety of prescriptions and methods are needed to achieve the desired density, size class and arrangement, and that the Proposed Action in the Jacob-Ryan project is the first step toward this desired condition.

Comment 4: Let the folks in local communities as stakeholders take part in solutions by creating opportunities for work and economic well being and along with re-establishing a progressive community capacity in acquiring needed tools and skills for helping maintain diverse, healthy productive and sustainable forest ecosystems. (Category S, Letter 1, Paragraph 3, Line 4, page 2)

Response: The Forest Service published a scoping notice for the proposed project in two local newspapers and on the Forest Service website asking for public involvement and comment. We also sent out over 70 scoping notice letters to individuals and groups asking for their involvement and comment. The scoping comment period remained open to all commenters for the whole analysis period. We held meetings and field trips to discuss and solicit comments during the analysis period. We also published the announcement of the 30 day comment period following the publishing of the Environmental Assessment.

We received five comment letters from the scoping notice and four comment letters on the Environmental Assessment.

Comment 5: Although CCF figures have been calculated in this document the EA does not attach specific dollar values to the two treatment alternatives. Doing so would help clarify the operational cost and benefits associated with a 12 inch versus 18 inch diameter cap. (Category S, Letter 3, Paragraph 1, Line whole paragraph, page 4)

Response: The initial economic analysis did provide dollar values for the two action alternatives as well as for full implementation. Prior to completion of the Environmental Assessment the local timber market took a downturn and the price per CCF dropped dramatically. Existing timber

contracts were put on hold and in one case defaulted because of the lack of profitability. The prices used for the original calculations were no longer reliable for this variable market. As a result, we felt it would be more appropriate to publish the potential commercial harvest volume (CCF) for each alternative rather than use uncertain wood market figures.

Costs for implementing vegetation treatments include cruising/tree marking, non-commercial thinning, commercial-thinning, pile-burning and prescribed burning. Depending on site conditions, implementation costs vary. The cost for implementing the Proposed Action treatments is estimated between $250.00 and $300.00 per acre. The potential income from harvested trees ranges around $50.00 and $70.00 per acre. The estimated cost of implementing Alternative 3 is almost as much as the Proposed Action due to the amount of non-merchantable thinning needed, but the potential commercial volume from Alternative 3 is about one fourth of Alternative 2.

The No Action alternative would have no implementation costs, but the risk of uncharacteristic stand replacing fire would remain. Suppression costs for an uncharacteristic wildfire could run about $1,000.00 per acre (up to $26 million).

Range and Invasive Species

Comment 1: Current extent or rate of spread for cheatgrass especially in relation to Warm Fire. (Category T, Letter 3, Paragraph 3&4, Lines all, page 3)

Response: The known populations inside the project area are small isolated concentrations along roads. These populations are being treated and are expected to be controlled prior to Jacob Ryan implementation. Identified populations that are not controlled prior to project implementation would be deferred from vegetation management until the population is eradicated. Surveys and control of invasive species would occur in and around the project area before, during, and two years after implementation of the Jacob Ryan project.

Identified populations in the Warm Fire are being treated and controlled. Spread from these areas is expected to be minimal as they are being contained.

The Willis Fire was mentioned as an area of concern from cheatgrass invasion. Monitoring of the area where the fire occurred has been performed annually with the livestock grazing rotations on the Ryan Allotment. This area rehabilitated naturally with native grasses 20 years ago and continues to have a well above average ground cover frequency for the soil type. The competition provided by native grasses has a very low probability for cheatgrass establishment when combined with no expected disturbance from the Jacob Ryan project and continued best management practices.

Comment 2: Grazing conditions vs. No Action. (Category N, Letter 4, Paragraph 5, Lines all, page 18 and Paragraph 1, Lines all, page 19)

Response: Data has been collected to validate that watershed conditions have improved in areas affected by livestock. The analysis for the 2006 Houserock, Suicide, and Ryan Allotment Management Plan Environmental Analysis studied watershed and vegetation aspects of the Ryan allotment. The permanent transects read in 2004 and 2005 had the best results since their establishment in 1950's despite the fact that the readings followed a large drought cycle. Soils analysis confirmed that conditions have improved on the Ryan grazing allotment since comparable studies were performed in the 1980's. These transect readings, the Ryan allotment analyses, and watershed reports are kept at the North Kaibab Ranger District office. These improvements to vegetative and watershed conditions can be linked to modifications in grazing

management like reducing stocking rates, improving livestock distribution, lower allowable utilization rates, and a deferred rest rotation grazing system.

Our analyses have indicated that watershed conditions are improving and forage availability is excellent for the current livestock stocking rates. However, available forage is reducing at a small rate with continued overstory encroachment. Even though it would take decades of untreated and unchecked overstory species competition to reduce understory grasses and forbs to a level that there would not be sufficient forage for current livestock numbers, it is a reasonable prediction that more trees lead to less grass.

Comment 3: Fire regime and grazing allotments. (Category N, Letter 4, page 19 all, top page 20)

Response: With the low stocking rate on the rotation grazing that occurs on Ryan Allotment, livestock do not have the opportunity to graze grasses and forbs down to bare soil. Many of the research articles cited studied livestock impacts to fire regimes and seedling establishment in areas that have seen high intensity grazing for many years (ex. Madany and West 1983, Savage and Swetnam 1994). The allowable use rate on the Ryan Allotment is 40 percent of available species on each monitoring site. Average utilization has not reached above 20 percent since 2003 on any monitoring site.

The two year grazing deferment post burn treatment is a Kaibab National Forest guideline. It was also discussed that monitoring would be performed to determine whether two years' rest is sufficient. Pastures in which treatment occurred that are not deemed to be sufficiently recovered after the 2 years will continue to be rested until monitoring indicates other wise. The Forest is working with the Grand Canyon Trust and NAU on a research project that is studying livestock impacts to areas post fire, based in the Warm Fire. The study considers different soil types, and burn intensities; then grazes livestock at varying utilizations over the course of three years.

The outcome is expected to provide a science-based approach to determine an appropriate baseline livestock deferment interval period after a fire. It is important to note, that the outcome of this study would be a guideline for an appropriate rest interval using on site monitoring after the deferment interval to determine for whether or not grazing can resume. Factors that could extend the duration of the rest include but are not limited to precipitation, soil types, level of disturbance that created the need for the livestock deferral, and invasive species.

Comment 4: Invasive Weeds and livestock grazing. (Category N, Letter 4, all pages 20 and 21)

Response: Invasive weeds can be a valid concern to a vegetation management project. Livestock can create the disturbance for weed establishment and serve as a vector for seed to be transported. However, there are many methods for invasive species to spread other than livestock. Wildlife, people, vehicles, wind, and water can also spread weeds. The primary way that livestock spread weeds is when over utilization occurs, creating an opening for weeds to establish and spread. The utilization on the Ryan grazing allotment is light. The Jacob Ryan analysis area is currently under going survey for invasive species. Those detected are being treated and controlled. This effort will continue during the implementation of the project and 2 years after the project is completed. There will also be "best management practices" implemented to reduce introduction during the project. A healthy ecosystem combined with an aggressive invasive species program reduces the level of weeds to be spread.

Livestock are also being deferred for at least two years post prescribed burn with monitoring to determine if continued deferment is needed. Understory health and vigor as well as invasive species infestation is part of that monitoring. In the event that invasive species infestations are

found in the project area after implementation and are not controlled by the end of the two year livestock deferment, the rest period from grazing will be extended.

The locations of known spotted knapweed populations are disclosed in the table on page 89. The current known populations of cheatgrass occur along roads inside the project area. These areas are receiving treatment to control and eradicate the populations. Locations where infestations are not considered "eradicated" will be deferred from treatment until the infestation is controlled.

The North Kaibab RD has been performing monitoring on recent areas of disturbance where fire was utilized as a management tool. These areas include prescribed burning projects at the Big Saddle and Little Mountain and Wildland Fire Use on the 2008 Mill Fire and Betty Fires. Weed surveys were conducted to validate that invasive species were not present on the prescribed burns and fire use prior to establishment of a fire boundary. Best management practices include washing of equipment and vehicles that came from other areas. Follow up monitoring on all four of these fires initially found no presence of cheatgrass or noxious species. Monitoring will continue for two years post fire unless a species of concern is detected, in which case species control treatments will begin and the monitoring interval will be lengthened. The current lack of post fire invasive infestations supports our experience that low intensity burns in ponderosa pine can be effective for creating healthy ecosystems without promoting invasive species.

Comment 5: Non-native invasive weed species infestation and spread. (Category N, Letter 4, Paragraph 4, Lines all, page 23)

Response: From an invasives management aspect, the concern will be controlling infestations inside the project area before treatment and preventing new populations from establishing during and after treatment. It is possible that invasive species can be spread from other locations like other known populations, roads, recent areas of disturbance, and locations where livestock and wildlife have been prior to entering the project area. This could include areas on the Forest like the State Highway corridors, Warm Fire, and the 1996 Bridger Knoll Fire. However, there are other areas that could serve as a source that include where visitors are coming from or bird migration.

Known populations of noxious or invasive species of concern are being treated with the intention of control and then eradication. The Jacob Ryan project will be surveyed before, during, and after project implementation to detect invasive species. If and when these species are found, they would be controlled and eradicated.

Wildlife

Comment 1: The Proposed Action would thin trees up to 18" dbh to regulate the composition of ponderosa pine stands that host dwarf mistletoe (Arceuthobium campylopodum). This treatment has potential to eliminate important structural elements of critical wildlife habitat, particularly for northern goshawk and Kaibab squirrel (Sciurus aberti spp. kaibabensis). (Category B, Letter 4, last paragraph pg 9 and Paragraphs 1-3, Lines all, page 10)

Response: The Kaibab acknowledges the importance of dwarf mistletoe to wildlife. Garnett et al. (2006) documented squirrel use in 17% of available witches' brooms. As the number of branches within a broom and tree height increased so did the probability of Abert's squirrel use. As stated in the Wildlife Specialist's Report, "The selected nest tree is usually within the center of a group of trees with interlocking crowns. The proposed project design is to keep mistletoe infected trees greater then 18 inches DBH and maintains desired conditions for canopy cover, within the identified 1,000 acres to be treated. These criteria may remove some elements, but are not likely to eliminate important structural elements of critical wildlife habitat."

Mistletoe is a forage species for Kaibab deer; however the two main reported components of the Kaibab summer deer diet have been leaves of aspen and a variety of herbaceous plants characteristic of the forest understory (McCulloch and Smith 1991). The project would leave all over 18 inch infected trees maintaining enough mistletoe to supplement the Kaibab deer diet.

Comment 2: Burning of pine stands with high surface fuel loading also can result in extensive tree mortality (Hunter et al. 2007), and fire treatments may leave trees susceptible to delayed bark beetle infestation (Wallin et al. 2003). Additionally, large tree mortality has directly resulted from mechanical thinning activities (Hunter et al. 2007). Large snags and downed logs, which provide critical habitat for cavity-nesting birds, bats, small mammals, reptiles, amphibians and insects, are often destroyed by fuel reduction treatments (Hunter et al. 2007). (Category E, Letter 4, Paragraph 3, Lines all, page 3)

Response: Susceptibility to beetle infestation addressed in Silviculture section, Comment 3. Appendix I includes design criteria, BMPs and relevant Forest Plan standards and guidelines, the Fuels section states: "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." Fire management staff use the Silviculture prescription and fire modeling (including but not limited to: rates of spread, flame length, standard fuel conditions) to prepare a burn plan. Pre–burn preparations, such as removing excess fuels from around snags and downed logs may be implemented to meet the objectives for snags and downed logs.

Comment 3: The Proposed Action will not meet Forest Plan standards for vegetation structure in goshawk nest areas. Furthermore, the Jacob Ryan EA does not show how the Proposed Action will meet either of the "required" attribute sets, regardless of which Site Index value applies to the project area. However, the EA never quantifies Proposed Action effects on nest stand attributes. (Category M, Letter 4, Paragraph 8, Lines all, page 7 & Paragraph 1, Lines all, page 8)

Response: The proposed action is designed to move the forest toward a size class distribution as defined in the Forest Plan. Although it was not included in the EA, the project record includes a Site Index of 68.26 in un-even aged stands which exceeds the 55 site index from Table 5 of RM 217. The project record also quantifies the effects of the Proposed Action on nest stand attributes; the table is included in this response.

Table 1—Tree density stand statistics in uneven-aged existing nest areas

YEAR	TREES/AC	BASAL AREA	AVE. DBH	SDI
2008	609	127	6.0	295
2028	540	151	6.8	331
2048	460	166	7.8	348

Comments 4 and 5: The EA offers general statements about effects on sensitive, management-indicator and game species, without providing detailed information about past, ongoing or foreseeable activities that may cumulatively degrade or benefit wildlife habitat. It states that "Foreseeable future actions may include fuel reduction projects (thinning groups and prescribed burning)," but lacks specificity about where those actions might occur, when, how much habitat they might affect, or the intensity of possible effects (EA at 81). (Category N, Letter 4, Paragraph 5, Lines all, page 21 and Paragraph 6, Lines all, pages 21 and 22)

Response: Appendix E lists the past, ongoing and foreseeable activities. The table in the EA is indeed a summary of cumulative effects; the wildlife report further analyzes the cumulative effects

of each species. "Foreseeable" generally refers to actions that are identified on our Schedule of Proposed Actions and out-year projects where there is some certainty. Although it is reasonable to assume that there will be future fuels reduction projects; their potential to contribute to cumulative effects can not and would not be assessed until they are proposed.

Comment 6a: Further, the EA notes that pygmy nuthatch *(Sitta pygmaea)* uses late-seral ponderosa pine forest habitat in the Jacob Ryan Project area, and it describes certain direct and indirect effects to the management-indicator species, but it omits any mention of cumulative effects. (Category N, Letter 4, Paragraph 2 & 3, Lines all, page 22)

Response: Not including the pygmy nuthatch in Table 39 was an accidental omission and has been corrected. The pygmy nuthatch analysis is also included in the wildlife report.

Comment 6b: Pygmy Nuthatch continued….it fails to square this purported benefit with its admission elsewhere that grazing capacity also will increase as a result of proposed treatment (Id. at 87).

Response: Grazing numbers will not change and utilization studies of grazing within the Jacob Ryan project area have shown that cattle remove the seed heads off existing plants leaving the majority of the ground cover. This type of utilization should not disturb the over all microclimate necessary for insect occurrence and foraging opportunities for the nuthatch.

Comment 6c: The claim of "increased … ground cover" also is inconsistent with the statement elsewhere that "All mechanized timber activities remove vegetative ground cover, exposing bare soil in varying degrees and influencing runoff and erosion (Cram et al. 2007, Id. at 55).

Response: Short term disturbances to ground cover may occur due to mechanized timber activities; however those disturbances will be limited to specific isolated areas as noted in Appendix A. Increases in ground cover would be expected in the long term (>1-3 years) due to more open canopy and increased sunlight on forest floor, as well as reduced competition for nutrient and water resources from trees. There may be short term foraging displacement for the nuthatch but return quickly following vegetative recovery.

Comment 6d: Where the EA asserts that the Proposed Action would affect "less than 5% of the total ponderosa pine forest wide," (id. at 71 and 76), it overlooks pending proposals that also would affect significant amounts of such habitat, as in the McCracken Project on the Williams Ranger District.

Response: The Jacob Ryan EA was analyzed at three spatial scales: strata, project and landscape. The McCracken Project was included in the Forestwide MIS analysis. The objectives of the McCracken project, like the Jacob-Ryan project are to move the forest to the desired conditions identified in the Forest Plan. The proposed action (McCracken) as stated in the scoping document (September 11, 2008) has the potential to affect up to approximately 12,600 acres of ponderosa pine forest. At an estimated 480,390 acres of ponderosa pine cover type forest-wide, the cumulative effects of McCracken and Jacob Ryan are still less than 3% of total the ponderosa pine forest type on the Forest.

Silviculture

Comment 1: Implement an upper diameter limit of 12 inches diameter breast height (DBH) on tree removal in even-aged stands, and in existing and replacement nest areas (Category B, Letter 4, Paragraph 3 ,4, & 5, Lines all, Page 2).

Response: There are very few trees in the even-aged stands greater than 12 inches DBH. The nest stands would mostly be mechanically thinned from below to 12 inches DBH to help reduce the overstock of small trees, decrease fuel ladders, and improve fire-resistance in these critical habitat areas for the goshawk. However, retaining the flexibility to remove diseased or infested trees up to 18 inches in some locations would help attain desired conditions.

Comment 2: A 16 inch DBH upper diameter limit on tree removal in uneven-age stands both inside and outside PFAs is encouraged for JR. (Category B, Letter 4, Paragraphs 1&2, Lines all, page 3)

Response: A 16 inch diameter limit was initially considered, but removed from detailed analysis. Choosing an 18 inch over a 16 inch cutting limit in the uneven-aged stands occasionally provides for the removal of up to 2 trees more per acre as a difference between the 16 inch and 18 inch cutting limit (FVS stand data 2008). Abella et al. (2006) described the negative impacts with imposing 16 inch diameter limits for tree cutting to reductions in understory vegetation, biodiversity, nutrient cycling and water relations.

Comment 3: Given the possible risks of drought, beetle attack and post Rx mortality, the KNF should leave a greater proportion of VSS 4 trees uncut (Category M, Letter 3, Paragraph 4, Line 2, page 2).

Response: Mortality is factored into fire models, and design criteria such as test burns, raking around large trees in the burn plan and the silviculture prescription would establish the level of mortality that would not be exceeded (JR EA Appendix H p. 148). The negative impacts of leaving an over abundance of VSS 4 vegetation could lead to reductions in understory vegetation, biodiversity, nutrient cycling and water relations (Abella et al. 2006).

Comment 4: Vegetation Structure. The JR EA does not show how the Proposed Action will meet either of the required attribute sets; regardless of Site Index meeting require nest area attributes etc (Category M, Letter 4, Paragraph 2, Lines all, page 8).

Response: The project is retaining all large trees over 18 inches. Nest areas currently have attributes of large, mature trees, adequate canopy cover, but are too dense with trees less than 5 inches DBH. The site index for uneven-aged stands averages 68 at base age 100. We plan to thin ladder fuels, reduce competition, and improve fire-resistance. The Proposed Action is the first step toward balancing the age and size classes toward the desired 10-10-20-20-20-20.

The longer these stands are overstocked with small trees, the greater the risk of a stand replacing crown fire that not only destroys the habitat for nesting goshawks, but imperils fledglings not able to escape a wildfire. The Jacob-Ryan project is an initial step to reintroduce natural surface fire (See Table 2 in the wildlife section above for existing conditions in nest areas).

Comment 5: We encourage the FS to apply the following silvicultural principles to its group selection prescriptions.

- Retain old trees (>120 yrs) regardless of size.
- Retain young trees larger than 16" in uneven-aged stands and >12" in even-aged and goshawk nest stands.
- Retain trees in 0.1 – 1.0 acre groups with interlocking crowns.
- Tree groups may be aggregated and separated by openings of similar size or up to 2 acres.
- Residual basal areas generally range from 40-120 ft/acre, averaging not less than 60 ft/acre at the stand scale.
- Basal area measured within groups may exceed 200 ft/acre and may be less than 40 ft/acre

when measured in openings.
• Local groups of regeneration—seedlings and saplings—should be selectively retained.
• Tree removal generally focuses on the 4"-12" diameter classes.
• Mark leave trees.

(Category M, Letter 4, bulleted group selection principles on pg. 9 of this letter)

Response: We are retaining all pre-settlement trees regardless of diameter; plan no commercial harvest in the nest areas, and mostly thinning in even-aged stands. Implementation is designed to retain clumps with interlocking crowns and enhance existing openings in all stands. Basal areas from 40 – 120 are in range with desired conditions, but basal area within VSS 6 group is recommended to be 140 according to the KNF Interpretation and Implementation guidelines (2005). There would be a risk of bark beetle attack in groups with a basal area greater than 200. Seedlings and saplings with good phenotypes would be retained. Tree removal up to 18 inches DBH would focus on leaving the desired trees per acre and basal area in the guidelines, expanding and/or creating openings, and removing diseased or infested trees. The plan is to have a sample mark area for training and review.

Comment 6: There is an issue of mismatched scale in relating effects to terrestrial vegetation, soils and watershed conditions within the JR project area to Hydrologic Unit Codes (HUCs). Therefore, emphasis should bed placed on comparative analyses for these environmental conditions that can be related to the area inside the JR project boundary at a scale that can be more accurately tied to management goals. (Category N, Letter 3, Paragraph 2, Lines all, page 4).

Response: There were three levels of analysis in the Vegetation Report. An ad hoc area was established that covers most of the ponderosa pine community type surrounding JR. There is no requirement to match analysis scales for every resource as they vary according to need and effects of that resource. For example, soils cumulative effects cover a much larger area than silviculture or vegetation management.

Comment 7: VSS distribution – It fails to account for VSS1/2 patches created by the 2006 Warm Fire and subsequent tree planting adjacent to the recently changed Jacob Ryan Project area boundary (Category N, Letter 4, Paragraph 2, Line 3, page 5).

Response: The Ad hoc analysis and the Vegetation report address VSS distribution. The Vegetation Report (pg. 48) displays the VSS breakdown for the Warm Fire. The proposed action would replant about 10,000 acres of the Warm Fire, and reestablish VSS 1 in those areas.

Comment 8: We would be interested to see how the analysis might change if the Forest Service were to apply that direction as well as the guideline, "Identify and portray desired forest site condition for landscape or ad hoc area at 20 & 40 year time marks" (Category N, Letter 4, Paragraph 1, Line 3, page 6).

Response: The ad hoc analysis in the Supplemental Analysis addresses landscape conditions. The desired forest site condition for the landscape at 20 years is a fire-adapted system resilient to natural disturbance (wildfire, disease, insect attack, windstorms, and periodic drought). At 40 years, we plan for the establishment of multi-storied, uneven-aged stands with habitat for a host of species; the use of commercial and pre-commercial thinning; and prescribed fire to maintain fire-resistant forests.

Comment 9: But it does not indicate what VSS stages exist now or in the future in those areas, or how the Jacob Ryan Project might affect the broader scale balance of goshawk habitat at the spatial scale identified for analysis. (Category N, Letter 4, Paragraph 1, Lines all, page 23).

Response: Current VSS at the landscape level for the Warm Fire suppression area is a preponderance of VSS 1-2 (~70%), and there is a need to salvage and replant the same area. Commercial and pre-commercial thinning in the Fracas project would move the area toward the desired balance of age and size classes to maintain suitable wildlife habitat.

The density of small trees less than 5 inches in the ad hoc area, and fire use is still risky in many areas, especially when trees are 300 per acre or more. Some dog-hair thickets contain over 3000 trees per acre (2008 monitoring) and are ladder fuel components for moving wildfire into the crowns and overstory.

Comment 10: "Current and future vegetation management activities in the analysis area" including tree planting on 11,600 acres in the Warm fire area and thinning treatments on 2,000 acres "for goshawk habitat" in the Fracas Wildlife Project (Category O, Letter 4, Paragraph 1, Lines all, page 23).

Response: Current VSS at the landscape level is a preponderance of VSS 1-2, and the need to salvage and replant the Warm Fire. Commercial thinning and PCT at Fracas would move the area toward 10-10-20-20-20-20. Fracas is included in the Ad hoc analysis for VSS distribution.

We plan to replant about 10,000 acres of the Warm Fire (Silviculture report, Warm Fire FEIS 2008), mostly with ponderosa pine, and Douglas-fir (on sites with historical DF). This project would re-establish a ponderosa pine forest, protect watersheds, and provide wildlife habitat over time.

Fire and Fuels

Comment 1: Large down trees can slow sub-canopy horizontal wind movement and fire spread. Removal of large woody structure can diminish ecosystem resiliency to fire disturbance. (Category C, Letter 4, Paragraph 4, Lines all, page 10)

Response: Removal of large dead and down woody material is not a specific objective of this project and horizontal wind speed (mid-flame wind speed) is calibrated at approximately 6 feet above ground level. Most dead and down material is below 36 inches in height. Prescribed burning is the only activity that is planned to reduce large dead down woody material and may reduce the size and change the continuity of large dead material. However, it may not completely remove it from the forest floor. Large dead and down woody material may slow fire spread, but increases the resistance to control by increasing fire intensity, which in turn hinders the ability for firefighters to take suppression actions.

Comment 5: Intensity of fire behavior and the severity of its physical and biological effects partly depend on fuel properties and their spatial arrangement. (Category C, Letter 4, Paragraph 5, Lines all, page 10)

Response: "Bulk density" and "fuel loading" are similar units of measure that contribute to determining fire line intensity. Generally, fire line intensity is a combination of fuel loading, weather, fuel model and fuel moisture (Fire line Handbook, Appendix A). "Bulk density" is usually described in fire modeling as "canopy bulk density" which describes the areas ability to sustain canopy fire. For this reason, we generally use "fuel loading" as a unit of measure to not confuse the two terms. Fuel loading can include grass, shrubs, litter and dead woody material. However, it is usually defined in terms of 1 hour, 10 hour, 100 hour and 1000 hour fuels.

Comment 6: Shrubs and small trees influence crown fire ignition because they contribute to surface fire intensity and can serve as ladder fuels that facilitate vertical movement from the ground to the overstory. (Category C, Letter 4, Paragraph 6, Lines all, page 10)

Response: Most of the data used to determine "crown bulk density" or "canopy bulk density" were taken from actual stand exam plots within the unit. A silvicultural prescription will determine the intensity of canopy thinning. A goal of prescribed burning would be to naturally limb ladder fuels by raising the canopy base height of larger ponderosa and reducing the number of understory trees, which would allow for surface fire to pass through without reaching into the canopy.

Comment 7: Reducing the risk of active canopy fire that spreads among tree crowns independent of surface fire behavior may require heavy thinning, depending on stand structure and degree of acceptable risk. (Category C, Letter 4, All of page 11)

Response: This comment is very accurate. Modeling canopy fire relies on input data that can obtained from various methods. The method that was used for this project was the utilization of stand exam data taken from the project area.

Comment 8: Spatial orientation of strategic treatments for fire. The Forest Service should analyze these factors in the Jacob Ryan project area to demonstrate that its selection on proposed treatment locations best meet the purpose and need. (Category C, Letter 4, All of page 12)

Response: We would take into account all known best management practices and determine where to initiate treatment based on those practices. This project would not treat meadows, riparian areas or openings, but would utilize these areas as natural features for prescribed burning implementation. The direction of fire spread as well as the availability of fuels and topography will help determine the scheduling and location of treatment units.

Comment 9: Activity fuels increase short term fire hazard. Mechanical thinning under both action alternatives will cause forest stands currently exhibiting Fuel Model 9 to resemble Fuel Model 11 to 13 (light to heavy slash) before they look like Fuel Model 8. (Category C, Letter 4, all of page 13)

Response: Slash that is generated from thinning activities would generally be piled and burned at landings. Some logging units may have areas of "lop and scatter" located within open areas and away from nest sites. "Lop and scatter" activity will only occur where necessary and will be less than 2 feet in depth. Slash material would not be the primary carrier of the surface fire. Therefore, fuel model 11 was not selected to model these areas as it would only pertain to isolated portions of thinning units and would not affect the overall fire behavior for prescribe burn units. "Slashing" and then burning of units is not in the design criteria for this project. Prescribed burning of piled slash will occur annually following harvesting.

Comment 10: Disclosure of FFE-FVS fuel model limitations and environmental consequences to include scale dependence, fuel loads/decomposition and spatial accuracy. (Category C, Letter 4, pages 14 – 16 all)

Response: This level of detail is not usually included in EAs, but in the supporting specialists reports. The Fire and Fuels Extension of the Forest Vegetation Simulator was utilized to show a combined treatment scenario based on the weather at the 90th percentile and 50th percentile. The fuels parameters for the 90th percentile were Temperature @ 82 degrees, eye level wind speed of 8 mph, 1 hour fuel moisture @ 2%, 10 hour fuel moisture @ 2% and 100 hour fuel moisture @ 4% (from the fuel moistures relative humidity can be back calculated based on time of season). The 90th percentile weather scenario also utilized the "dry season" function located within the model and this season is typically in May, June and July for the Kaibab Plateau. The 90th percentile weather was used to explain the no-action alternative and the effects of the no-action alternative. The 50th percentile was used to simulate conditions that would be more moderate and would likely be the parameter in which prescribed burning would occur. These conditions fall within many of

our current fire treatment prescription parameters. The 50th percentile parameter were: temperature @ 70 degrees, eye level wind speeds @ 5 mph, 1 hour fuel moisture @ 5%, 10 hour fuel moisture @ 5% and 100 hour fuel moisture @ 10%. As with all models, the data utilized to create a scenario have limitations in time and space. The FFE-FVS tool was utilized only as a reference to what conditions may be developed from the implementation of alternatives. A site specific burn plan utilizing such tools as BEHAVE PLUS and FOFEM (or models predicting fire spread) will be utilized to model fire spread and intensity for specific burn units. From this model, a prescribed fire prescription will be established to include on-site fuel sampling data. The silvicultural prescription will be the basis for developing the prescribed fire burn plan and will include changes to vegetation structure as a result of thinning or wildfire disturbance in the immediate project area. These are more site specific implementation planning documents that utilize data taken during implementation activities within the project area. Brown's transect data were utilized in the modeling of the scenarios within the FFE-FVS program (these data were collected during stand exam monitoring). The "Forty fuel model" description tool developed by Scott and Burgen (2005) was considered and reference by the fuels specialist during the analysis of the alternatives. This fire behavior reference was not inserted into the EA because it has very similar input variables as fuel model 9. Spatial fuel model mapping is an ongoing project for the Kaibab National Forest; however it is not within the scope of this EA to accomplish this action.

Comment 12: Analyze indirect & cumulative effects of large tree removal on stand and landscape scale fire regimes. (Category N, Letter 4, Paragraph 3, Line 3, page 4)

Response: This project does not remove large trees with prescribed burning nor would large trees be removed as part of mechanical treatments. Fire regimes were analyzed and are listed in EA document (page 40).

Comment 13: Fire and fuels analysis easily could apply findings regarding cumulative actions including the Fracas Wildlife Project and the Warm Fire Recovery Project, in addition to past actions, to model potential fire behavior and effects at the scale identified. It does not. (Category N, Letter 4, Paragraph 2, Lines all, page 23)

Response: The Warm Fire EIS does not have a major impact to the Jacob Ryan project, because there is no potential prescribed burning in the Warm Fire project (other than pile burning) associated with the proposed action. The Fracas Wildlife Project does not have the scale of burn treatment identified in the Jacob-Ryan project, but a fire and fuels analysis was considered in the Jacob Ryan EA (pg 43).

Soils and Watershed

Comment 1: It appears to us that soils exhibiting unsatisfactory or impaired conditions located in map units 9, 273, 293, 620 and 624 will experience disturbance to varying degrees as a result of the Proposed Action. (Category F, Letter 4, Paragraph 2, Line 2, 3 & 4, page 17)

Response: Based on the information presented in Table 7, Table 10 and Table 11 of the *Soil and Water Environmental Consequences* section of the Soil & Watershed Specialist Report, ecological map unit 273 will not to be commercially thinned, pre-commercially thinned or broadcast burned as a result of the Proposed Action. Map units 293, 620 and 624 have impaired conditions due to the lack of course woody debris. Implementation criteria would leave activity created materials in place to supplement the soil. Map unit 9 has mitigation and special BMPs to protect soils in these areas.

Comment 2: The EA does not quantify the extent of soil compaction in any map unit, although it indicates that this is currently a concern in map unit 9. (Category F, Letter 4, Paragraph 1, Lines 4 & 5, page 17)

Response: Based on the collection of field data for the Jacob-Ryan project area, ecological map unit 9 was the only map unit where described surface soil properties were found to be compacted. Surface soil properties described in the remaining ecological map units for this project did not indicate soil compaction.

Comment 3: It is not clear from the analysis what factors account for unsatisfactory or impaired conditions in map units 272 and 624. (Category F, Letter 4, Paragraph 1, Line 6 & 7, page 17)

Response: Based on the collection of field data within ecological map unit 272, it was found to be impaired due to erosion. Soil conditions for ecological map unit 272 are presented under the *Pinyon Pine - Utah Juniper Woodland* Section of the *Existing Soil Condition Assessment* of the Soils & Watershed Specialist Report for this project.

Ecological map unit 624 was found to be impaired due to inadequate amounts of downed coarse woody debris. Soil conditions for ecological map unit 264 are presented under the *White fir/Douglas Fir/Ponderosa Pine/Gambel Oak Forest* Section of the *Existing Soil Condition Assessment* of the Soils & Watershed Specialist Report for this project.

Comment 4: Project design criteria would "minimize soil impacts" to map unit 9, however, it is not clear from the analysis that effective ground cover would be maintained within "tolerable" limits on those 356 acres and that "impaired" conditions would be avoided where they are currently "unsatisfactory." (Category F, Letter 4, Paragraph 3, Line 1, 2, 3 & 4, page 17)

Response: The *Best Management Practices* section of the Soil & Watershed Specialist Report and in Appendix H of the EA specifically address and mitigate soil loss tolerance, course woody debris, hand and machine slash piling and broadcast burning.

Comment 5: This may not be a sufficient margin to prevent proposed logging activities from creating "impaired" conditions on map unit 9 soils: "Assume tree harvest and associated activities (temp road clearing, skid trails, landings, etc.) will result in zero ground cover over 10 percent of each TES Unit cut (Dave Brewer KNF Range and Watershed Specialist 4/3/2003)" (Beck 2003). (Category F, Letter 4, Paragraph 3, Line 4, 5, 6, 7, 8 & 9, page 17)

Response: Best Management Practices identified in the Soil & Watershed Specialist Report and in Appendix H of the EA, address "tree harvest and associated activities (skidding, temp road clearing, skid trails, landings, season of operation etc.)" in ecological map unit 9.

Comment 6: The Jacob Ryan EA does not indicate how design criteria such as directional tree falling and end-lining felled trees would prevent potentially significant impacts to ground cover exceeding tolerable limits in map unit 9 (EA at 54). Category F, Letter 4, Paragraph 3, Line 9, 10 & 11, page 17)

Response: By permitting only directional falling and end-lining of felled trees at the same time not allowing tractor skidding and log landings in ecological map unit 9, would significantly minimize the impacts on vegetative cover. Applying all applicable Best Management Practices also minimizes the impacts on vegetative cover. Additional vegetative ground cover would be added due to lop and scatter of logging slash. Refer to responses to comments 3 and 4 above.

Comment 7: A similar concern applies to soils in map units 263, 299 and 625, all of which are currently within 10 percent of "tolerable" limits for ground cover now (id. at 49 (Table 30)), and

none of which appear to be designated for such specific project design features as apply to map unit 9 (id. at 54). (Category F, Letter 4, Paragraph 3, Line 11, 12 & 13, page 17)

Response: Based on the information presented in Table 7, Table 10 and Table 11 of the *Soil and Water Environmental Consequences* section of the Soil & Watershed Specialist Report, ecological map units 263, 299 and 625 are not to be commercially thinned, pre-commercially thinned or broadcast burned.

Comment 8: …..and for unspecified reasons in 624 – we assume the concern here is compaction because ground cover exceeds tolerable minimum values in 624. (Category F, Letter 4, Paragraph 4, Line 5, 6 & 7, page 17)

Response: The concern is not compaction; it is the lack of coarse woody debris. Refer to response to comment 2 above.

Comment 9: It also does not quantify how much additional soil disturbance will result from the Proposed Action – this is of particular concern in map unit 620 because adequate ground cover does not currently exist, and the EA proposes no special design features as in map unit 9 (above) other than weather-constrained logging. (Category F, Letter 4, Paragraph 4, Line 9, 10 & 11, page 17)

Response: Under the *Best Management Practice* section of the Soil & Watershed Specialist Report, it is stated that "each project is required to identify and implement site specific Best Management Practices designed to protect soil and water quality (Interagency Agreement, 1990)." Best Management Practices identified in the Soil & Watershed Specialist Report and the Soil and Watershed section in Appendix A of the EA (BMPs A & D-M), are designed when implemented to minimize soil disturbance and address the maintenance or improvement of vegetative ground cover in <u>all</u> ecological map units.

Comment 10: The Jacob Ryan EA states that its cumulative effects analysis area "includes the Kanab Creek (15010003) and Marble Canyon (15010001) watersheds,"…(Category N, Letter 4, Paragraph 2, Line 1 & 2, page 18)

Response: Under the *Watershed Cumulative Effects* section of the Soil & Watershed Specialist Report, it specifically states that "The Jacob-Ryan Vegetation Management Project cumulative effects area consist of four 5th-code watersheds. These are the House Rock, Lower Johnson, White Sage and Snake Gulch 5th code watersheds."

Comment 11: The Jacob Ryan EA does not contain the kind of detail needed to inform a finding of no significant impact on soils in the analysis area given the extent and intensity of past, ongoing and foreseeable road building, grazing, and logging with ground-based equipment. (Category N, Letter 4, Paragraph 3, Line 6, 7, 8 & 9, page 18)

Response: There is no road building proposed in this project. Other management activities (grazing, and logging with ground-based equipment) occurring within the cumulative effects analysis area are identified and their effects on soils are described. Both direct and indirect effects of past, present, and future activities are considered. Refer to the *Watershed Cumulative Effects* section of the Soil & Watershed Specialist Report.

Comment 12: ....including the concurrently proposed Warm Fire Recovery Project on highly sensitive recovering burned soils in the same ecological map units as in the Jacob Ryan Project area. (Category N, Letter 4, Paragraph 3, Line 9, 10 & 11, page 18)

Response: The same ecological map units in the Jacob Ryan Project area do occur within the Warm Fire Recovery Project area; however, polygons of the same ecological unit in the Jacob-

Ryan Project are not the same polygons that occur within the Warm Fire Recovery Project area. Several hundred acres of the Warm Fire Recovery Project area were removed from the Jacob-Ryan Project analysis area (EA, page 5).

Comment 13: The Jacob Ryan EA quantifies the acreage affected by various management activities (but not roads) in Appendix E. (Category N, Letter 4, Paragraph 4, Line 1, page 18)

Response: There is no road construction or reconstruction as part of this project. Some closed road would be reopened for project implementation and closed at the completion of the project. Any road use is considered as a direct effect and is discussed in the *Watershed Cumulative Effects* section of the Soil & Watershed Specialist Report.

Comment 14: It contains no objective quantification of cumulative impact on key soil productivity indicators such as compaction and ground cover. (Category N, Letter 4, Paragraph 4, Line 2 & 3, page 18)

Response: The cumulative effect area or portions of the cumulative effect area are subjected to various management activities such as grazing, timber harvest activities, fire, and recreation activities. Key indicators of soil productivity such as erosion, displacement, compaction, and vegetative ground cover are described with each management activity identified within the cumulative effect area. Refer to the *Indirect Effects* portion in the *Watershed Cumulative Effects* section of the Soil & Watershed Specialist Report.

Comment 15: It does not mention the fire suppression operations that occurred during the 2006 Warm Fire, which may have caused significant adverse soil disturbance independent of the fire itself (Backer et al. 2004). (Category N, Letter 4, Paragraph 4, Line 3, 4 & 5, page 18)

Response: This is address in the Soil & Watershed Specialist Report Supplement (PR 47).

Comment 16: ….but it is not a sufficient description of the actual environmental effects that can result from disturbing those acres. (Category N, Letter 4, Paragraph 4, Line 3, 4 & 5, page 18)

Response: Key indicators of soil productivity such as erosion, displacement, compaction, and vegetative ground cover are described with each management activity identified within the cumulative effect area. Refer to *the Indirect Effects* portion in the *Watershed Cumulative Effects* section of the Soil & Watershed Specialist Report.

Comment 17: There is an issue of mismatched scale in relating effects to terrestrial vegetation, soils and watershed conditions within the JR project area to Hydrologic Unit Codes (HUCs). The extent of the two HUCs that fall partially within the JR project boundary Kanab Creek (1,094,129 acres) and Marble Canyon (939,067 acres) are so large as to swamp out any project-level effects that are analyzed at the HUC scale. Therefore, emphasis should be place on comparative analyses for these environmental conditions that can be related to the area inside the JR project boundary at a scale that can be more accurately tied to management goals. (Category N, Letter 3, Paragraph 2, page 4)

Response: Ecological map units provided the basis for collecting field data, assessing existing soil conditions and evaluating effects of the proposed action. Existing soil condition information was described in each ecological map unit and presented by each vegetation type in the *Existing Soil Condition Assessment* section of the Soil & Watershed Specialist Report. Information was also aggregated up and reported by 4th code watershed (Kanab Creek and Marble Canyon) because the Arizona Department of Water Quality evaluated the status of water quality in Kanab Creek which drains a 4th code watershed. The status of water quality for Marble Canyon portion (which also drains a 4th code watershed) of the Colorado River was not reported in ADEQ's Draft 2006

biennial report. However, for assessing watershed cumulative effects, the cumulative effects analysis area was four 5th code watersheds.