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Region**

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Environmental Assessment for Jacob-Ryan Vegetation Management Project

Kaibab National Forest
Coconino County, Arizona

**Townships 38 & 39 North; Ranges 1 & 2 East,
Gila & Salt River Baseline and Meridian**

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ACRONYMS

(ATV) All Terrain Vehicle
(ADEQ) Arizona Department of Environmental Quality
(ADOT) Arizona Department of Transportation
(BA) Basal Area
(BMPs) best management practices
(CBD) Canopy Bulk Density
(CBH) Canopy Base Heights
(CEA) Cumulative effects analysis
(CI) Crowning index
(CWD) course woody debris
(DBH) diameter at breast height
(DRC) diameter at root collar
(DWD) down woody debris (synonymous w. CWD)
(EA) Environmental Assessment
(EIS) Environmental Impact Statement
(EMA) ecosystem management area
(EMU) ecological map units referring to soil mapping units and is synonymous with the Terrestrial Ecosystem Survey (TES) mapping units.
(FA) northern goshawk foraging area
(FEIS) Final Environmental Impact Statement
(FlamMap) A fire modeling software tool.
(Forest Plan) Kaibab National Forest Land Management Plan, April 1988 (as amended)
(Forest Plan S & G's) Kaibab National Forest Land Management Plan, April 1988 (as amended)
(FRCC) Fire regime condition class
(FS) Forest Service
(FVS) Forest Vegetation Simulator
(FVS-FFE) Forest Vegetation Simulator with the Fire and Fuels Extension
(GA) Geographical Areas
(GIS) Geographic Information System
(JR) Jacob-Ryan Vegetation Management Project
(KNF) Kaibab National Forest
(KNF I&I) (Implementation and Interpretation of Management Recommendations for the Northern Goshawk, v. 3, 2009)
(MSO) Mexican spotted owl
(NEPA) National Environmental Policy Act of 1969 (as amended)
(NKRD) North Kaibab Ranger District
(OG) Old growth
(PFA) northern goshawk post-fledging family areas
(PFFPP) Plateau Facility Fire Protection Project
(SDI) Stand Density Index

(TEAMS) is a unit of the Forest Service Enterprise Program. Enterprise Units are independent, financially self-sustaining entities that are funded by the customers they serve.
(TES) Terrestrial Ecosystem Survey soil mapping units, synonymous w. EMU.s
(TI) Torching index
(TPA) Trees per acre
(USDA) United States Department of Agriculture
(USFWS) United States Fish & Wildlife Service
(VSS) Vegetation Structural Stages
(WUI) Wildland Urban Interface

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TERMS & DEFINITIONS

General

Age class is defined as trees that originated within a relatively distinct range of years. Typically the range of years is considered to fall within 20 percent of the average natural maturity (e.g. if 100 years is required to reach maturity, then there would be five 20-year age classes).

Basal Area is the cross-sectional area at breast height (4.5 ft above the ground) of trees measured in square feet. Basal area is a way to measure how much of a site is occupied by trees. The cross-sectional area is determined by calculating the tree's radius from its diameter (diameter/2 = radius) and using the formula for the area of a circle (π x radius^2 = cross-sectional area). Basal area per acre is the summation of the cross-sectional area of all trees in an acre or in a smaller plot used to estimate basal area per acre. It is typically represented as square feet per acre.

Best Management Practice (BMP) is defined as methods or techniques found to be the most effective and practical means in achieving an objective (such as preventing or minimizing pollution) while making the optimum use of the firm's resources. BMP in general terms is a practice that is usually accepted as standard industry practice on either an implementation or engineered application that helps prevent or mitigate effects on the environment. Regarding water quality a BMP is defined by 40 CFR 130 as a practice, or combination of practices, that have been determined to be most effective and practicable in preventing or reducing the amount of pollution generated by diffuse sources to a level compatible with water quality goals.

Canopy Base Heights (CBH) is the lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy. CBH is an effective value that incorporates ladder fuels such as shrubs and understory trees (Scott and Reinhardt, 2001).

Canopy Bulk Density (CBD) is the mass of available canopy fuel per unit canopy volume. It is a bulk property of a stand, not an individual tree (Scott and Reinhardt, 2001).

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

Coarse woody debris is woody material on the ground greater than three inches in diameter, including logs.

Commercial Thinning is the cutting for the sale of products (poles, posts, pulpwood, etc.) in immature stands to improve the quality and growth of the remaining.

Crowning Index (CI) is the open wind speed above which an active crown fire is possible for the specified fire environment.

Declining refers to the senescent (aging) period in the lifespan of plants that includes the presence of dead and/or dying limbs, snag-tops, and other characteristics that indicate the later life-stages of vegetation.

Diameter at breast height (DBH) is the diameter of a tree typically measured at 4.5 feet above ground level.

Diameter at root collar (DRC) is the diameter typically measured at the root collar or at the natural ground line, whichever is higher, outside the bark. For a multi-stemmed tree, DRC is calculated from the diameter measurements of all qualifying stems ($\geq$ 1.5 inches diameter and at least one foot in length).

Down Woody Debris (DWD) is synonymous with CWD and is defined as woody material on the ground greater than three inches in diameter, including logs.

Ecological Map Unit (EMU) refers to soil mapping units and is synonymous with Terrestrial Ecosystem Survey (TES) soil mapping units.

Ecosystem Management Area (EMA) is a landtype association broken out by a specific ecosystem type or landscape which is used for scales of assessments when comparing existing and desired conditions of specific projects or proposals. The EMA is considered a landscape area that can range in size from a hundred to thousands of acres.

Effects are results expected to be achieved relating to the physical, biological, and social (cultural and economic) factors resulting from a land use or activity. Examples of effects are tons of sediment, pounds of forage, person-years of employment, income, etc. There are direct effects, indirect effects, and cumulative effects.

Even-aged forests are forests that are comprised of one or two distinct age classes of trees.

Even-aged Silviculture is the combination of actions that results in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and therefore tree sizes) throughout the forest area. Regeneration in a particular stand is obtained during a short period at or near the time that the stand has reached the desired age or size and is harvested. Clearcutting, shelterwood cutting, seed tree cutting, and their many variations are the cutting methods used to harvest the existing stand and regenerate a new one. In even-aged stands, thinnings, weedings, cleanings, and other cultural treatments between regeneration cuts are often beneficial. Cutting is normally regulated by scheduling the area of harvest cutting to provide for a forest that contains stands having a planned distribution of age classes. [36 CFR 211.3(k) NFMA Regulations.]

Fire regime refers to the patterns of fire that occur over a long period of time across an appropriately scaled area (outlined below) and its immediate effects on the ecosystem in which it occurs. There are five fire regimes which are classified based on frequency (average number of years between fires) and severity (amount of replacement on the dominant overstory vegetation) of the fire. These five regimes are:

Fire regime I – 0 to 35 year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (< 75% of dominant overstory vegetation replaced);

Fire regime II – 0 to 35 year frequency and high severity (> 75% of dominant overstory vegetation replaced);

Fire regime III – 35 to 100+ year frequency and mixed severity;

Fire regime IV – 35 to 100+ year frequency and high severity;

Fire regime V – 200+ year frequency and high severity

Fire regime condition class (FRCC) is an index of ecological departure from reference fire conditions from 1 to 3 with 1 being the least amount of departure. The FRCC departure metric can be derived by evaluating the change in composition of succession classes, fire frequency, and fire severity (Hann and others 2004).

FlamMap is a computerized and manual system utilized in modeling wildland fire behavior, which has long been available (Rothermel 1983, Andrews 1986). These systems focus on one-dimensional behaviors and assume the fire geometry is a spreading line-fire (in contrast with point or area-source fires). Models included in these systems were developed to calculate fire spread rate (Rothermel 1972, Albini 1976), fire shape (Anderson 1983, Alexander 1985), spot fire distance (Albini 1979, 1983) and crown fire spread rate (Van Wagner 1977, Rothermel 1991). The FlamMap program was developed for extending the utility of these models to a landscape-level where the necessary inputs have been mapped using geographic information systems (GIS).

Forest Health is the perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance; note perception and interpretation of forest health are influenced by individual and cultural

viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time (Society of American Foresters 2008). A healthy forest is also ecologically sustainable and habitat for native plant and animal species. (note: in terms of the Jacob-Ryan project and the ponderosa pine type forest which is habitat for northern goshawk and its prey species, areas that are outside nest areas are considered a healthy forest when managed as a dynamic condition towards an uneven-aged stratum within the PFA and FA.)

Forest Vegetation Simulator (FVS) is a family of forest growth simulation models. The basic FVS model structure has been calibrated to unique geographic areas to produce individual FVS variants. Since its initial development in 1973, it has become a system of highly integrated analytical tools. These tools are based upon a body of scientific knowledge developed from decades of natural resources research.

Forest Vegetation Simulator with the Fire and Fuels Extension (FVS-FFE) is the above mentioned growth simulation model coupled with fire modeling extensions (FFE).

Gap refers to the space occurring in a forested area as a result of individual or group tree mortality from small disturbance events or from local site factors such as soil properties that influence vegetation growth patterns.

Geographical Area (GA) is usually made up of one or more Ecosystem Management Areas (EMAs) and for purposes of the Forest Plan, is defined as a landscape which is usually a contiguous portion of one Geographic Area. GAs are similar to the larger Management Areas in the original (1988) Plan except for some minor boundary changes and logical combinations made as more complete information about physical resources has been acquired. Per the Forest Plan a GA is a sub-section of land or land management unit used in coordination and regulation of resources and issues within the Forest. GAs usually ranges in size from hundreds to tens of square miles in size.

Geographic Information System (GIS) is a system for storing and manipulating geographical information on computer.

Group refers to a cluster of two or more trees with interlocking or nearly interlocking crowns at maturity surrounded by an opening. Size of tree groups is typically variable depending on forest type and site conditions and can range from fractions of an acre (a two-tree group) (i.e. ponderosa pine, dry mixed conifer) to many acres (i.e. wet mixed conifer, spruce fir). Trees within groups are typically non-uniformly spaced, some of which may be tightly clumped.

Group Selection Cutting involves the removal of small groups of trees to meet a predetermined goal of age distribution and species in the remaining stand. The distance across an opening created by removal of a group of trees is usually no more than one to two mature tree heights.

Habitat is the place where animals live. The part of the environment occupied by an animal or plant, for example, stream, meadowland, or forest. It can be water for beaver, fish, and aquatic insects; rocks for reptiles, bats, and some species of birds; or forested areas for many mammals, birds, and reptiles.

Habitat Type is an aggregation of all land areas potentially capable of producing similar plant communities at climax.

Invasive species are species that are not native to the ecosystem being described. For all ecosystems, the desired condition is that invasive species are rarely present, or are present at levels that do not negatively influence ecosystem function.

Non-Commercial Thinning is thinning of the vegetation for non-commercial purposes (usually for fuel load reduction, and sometimes accomplished through use of in-kind services or stewardship programs).

Old-Growth (OG) is the last stage in forest succession. OG habitat is the sum of the physical and biological components of OG forest that are essential to maintaining populations of certain OG dependent species of

wildlife. [note: OG in Southwestern forested ecosystems is different than the traditional definition based on Northwestern infrequent fire forests. Due to large differences among Southwest forest types and natural disturbances, old growth forests vary extensively in tree size, age classes, presence and abundance of structural elements, stability, and presence of understory (Helms 1998). In the desired conditions, "old growth" is defined as: in frequent fire forest types (e.g. ponderosa pine, dry mixed conifer), OG typically occurs as groups of old trees interspersed with groups of younger trees, but sometimes as patches of mainly old trees. In infrequent fire forest types (spruce-fir, wet mixed conifer), old trees can occur in large patches. OG forests typically support communities of plants and animals that are associated with or require large old trees. A single old tree is not "old growth," although old trees must be present, "old" is a relative term that varies among species.] In the current Forest Plan, see Table 15, page 34 for OG characteristics.

Openings are spatial breaks between groups or patches of trees containing grass, forb, shrub, and/or tree seedlings but are largely devoid of big trees.

Patches are areas larger than tree groups in which the vegetation composition and structure are relatively homogeneous. Patches comprise the mid-scale, thus they range in size from 100 to 1,000 acres. Patches and stands are generally synonymous terms. [note: within JR project area stands range from 1 acre to 100's of acres in size, with a mean size of 59 acres.]

Regeneration is (1) the actual seedlings and saplings existing in a stand. (2) the act of establishing young trees naturally or artificially.

Regeneration Cut is the removal of trees with the intention of establishing a new crop of seedlings.

Site is the area in which a plant or stand grows, considered in terms of its environment, particularly as this determines the type and quality of the vegetation the area can carry - note sites are classified either qualitatively, by their climate, soil, and vegetation, into site types, or quantitatively, by their potential wood production, into site classes – also see habitat. [definition from Society of American Foresters website: http://dictionaryofforestry.org/dict/]

Stand: (1) ecology a contiguous group of similar plants (2) silviculture a contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit - see all-aged stand, mixed, pure, even-aged, and uneven-aged stands - note 1. a mixed stand is composed of a mixture of species - note 2. a pure stand is composed of essentially a single species - note 3. in a stratified mixture stand different species occupy different strata of the total crown canopy. [definition from Society of American Foresters website: http://dictionaryofforestry.org/dict/]

Stand Density Index (SDI) is a measure of relative stand 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 per acre. The onset of self-thinning or competition-induced mortality occurs when SDI is at 57 percent of maximum potential site occupancy.

Snags are standing dead or partially dead trees (snag-topped), often missing many or all limbs. They provide essential wildlife habitat for many species and are important for forest ecosystem function.

Shelterwood-seed tree treatment is an even-aged regeneration system designed to establish a new tree crop under a portion of the old stand, which provides both the seed source and shelter for the new seedlings. The mature trees are removed in two or more cuts. (1) The preparatory cut removes a portion of the mature trees and is intended to make the remaining trees more wind firm; (2) The seed cut removes additional trees with the intent of allowing additional sunlight to reach the forest floor. The seed cut leaves adequately spaced seed-bearing trees and opens the stand to provide conditions for restocking and the

establishment of a new stand of trees. The new trees become established following the seed cut. (3) The removal cut removes the last of the mature seed-bearing trees in that stand.

Torching Index (TI) represents the wind speed at which fire could be expected to move from surface fuels into crown fuels, is highly influenced by vertical stand structure (ladder fuels).

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

Vegetation Structural Stages (VSS) (desired VSS according to the Kaibab Forest Plan) for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS1), 10% seedling-sapling (VSS2), 20% young forest (VSS 3), 20% mid-aged forest (VSS4), 20% mature forest (VSS 5), 20% old forest (VSS6). Except for canopy cover, the VSS distribution and structural conditions are the same within and outside the post-fledgling family area. NOTE: The specified percentages are a guide and actual percentages are expected to vary + or – up to 3%.

Wildland Urban Interface (WUI). WUI includes those areas of resident populations at imminent risk from wildfire, and human developments having special significance. These areas may include critical communications sites, municipal watersheds, high voltage transmission lines, observatories, church camps, scout camps, research facilities, and other structures that if destroyed by fire, would result in hardship to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved.

Definitions related to northern goshawk

Nest areas are the areas immediately around a nest that are used by northern goshawks in relation to courtship and breeding activities. They contain multiple groups of large, old trees with interlocking crowns. The nest areas and replacement nest areas should be approximately 30 acres in size. A minimum total of 180 acres of nest areas should be identified within each post-fledgling family area.

Post-fledging Family Areas (PFAs) are the areas that surround the nest areas. They represent an area of concentrated use by the goshawk family until the time the young are no longer dependent on adults for food. PFAs are approximately 420 acres in size (not including the areas in suitable and replacement nest areas). Post-fledgling family areas (PFA) will be approximately 600 acres in size. Post-fledgling family areas will include the nest sites and consist of the habitat most likely to be used by the fledglings during their early development. Establish a minimum of three nest areas and three replacement nest areas per Post-fledgling family area.

Foraging areas are the areas that surround the PFAs that goshawks use to hunt for prey. They are approximately 5,400 acres in size (not including nest areas and PFA acres).

CHAPTER 1 – INTRODUCTION

1.1 Background

The original Jacob-Ryan project was initiated in 1998 and has gone through multiple changes up to the present. The most current past proposal used an 18-inch diameter cutting limit for treating approximately 26,000 acres of ponderosa pine type forest. Implementation of the past proposal would have required an amendment to the forest plan, yet the past proposal still did not fully meet the purpose and need for this project, or the desired conditions as outlined in the *Kaibab National Forest Land Management Plan* (Forest Plan), April 1988 - as amended. Therefore, in order to give detailed consideration to a project proposal that implements the Forest Plan, as it relates to management of northern goshawk habitat, this Jacob-Ryan Vegetation Management (JR) project is being brought forward independent of any previous Jacob-Ryan proposals or alternatives.

This JR project lies within the north-central tip of the Kaibab Plateau's forested land (which is predominately ponderosa pine) within the Kaibab National Forest (KNF), Coconino County, Arizona, approximately 20 miles southeast of the town of Fredonia along highway 89-A. (See Figure 1).

1.2 Document Structure

The Forest Service has prepared this Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) of 1969, (40 CFR 1508.9) as amended, and other relevant federal and state laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four parts:

- Introduction (Chapter 1): The section includes a brief history of the project proposal, the agency's proposal (proposed action) as it relates to the Forest Plan and management of the forest under northern goshawk guidelines, and the purpose of and need for the project as it relates to the proposed action. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- Comparison of Alternatives (Chapter 2), including the Proposed Action: This section provides a more detailed description of the agency's proposed action, as well as the alternatives to the proposed action (i.e., the no-action alternative and another alternative) in trying to achieve the stated purpose and need of the project as it relates to the Forest Plan. The alternatives were developed based on important issues raised by the public and other agencies. This discussion also includes proposed mitigation measures and/or best management practices. Finally, this section provides a summary of the environmental consequences associated with each alternative.
- Environmental Consequences (Chapter 3): This section describes the environmental effects of implementing the proposed action and other alternatives (i.e., the no-action alternative and the other-action alternative). This analysis is organized by resource area and /or important issues. Within each section, the affected environment is described first, followed by the effects of the Proposed Action Alternative, the No Action Alternative (which provides a baseline for evaluation and comparison), and the other action alternative.
- Agencies and Persons Consulted (Chapter 4): This section provides a list of preparers and agencies consulted during the development of the environmental assessment.
- Appendices: The appendices provide more detailed information to support the analyses presented in the environmental assessment.

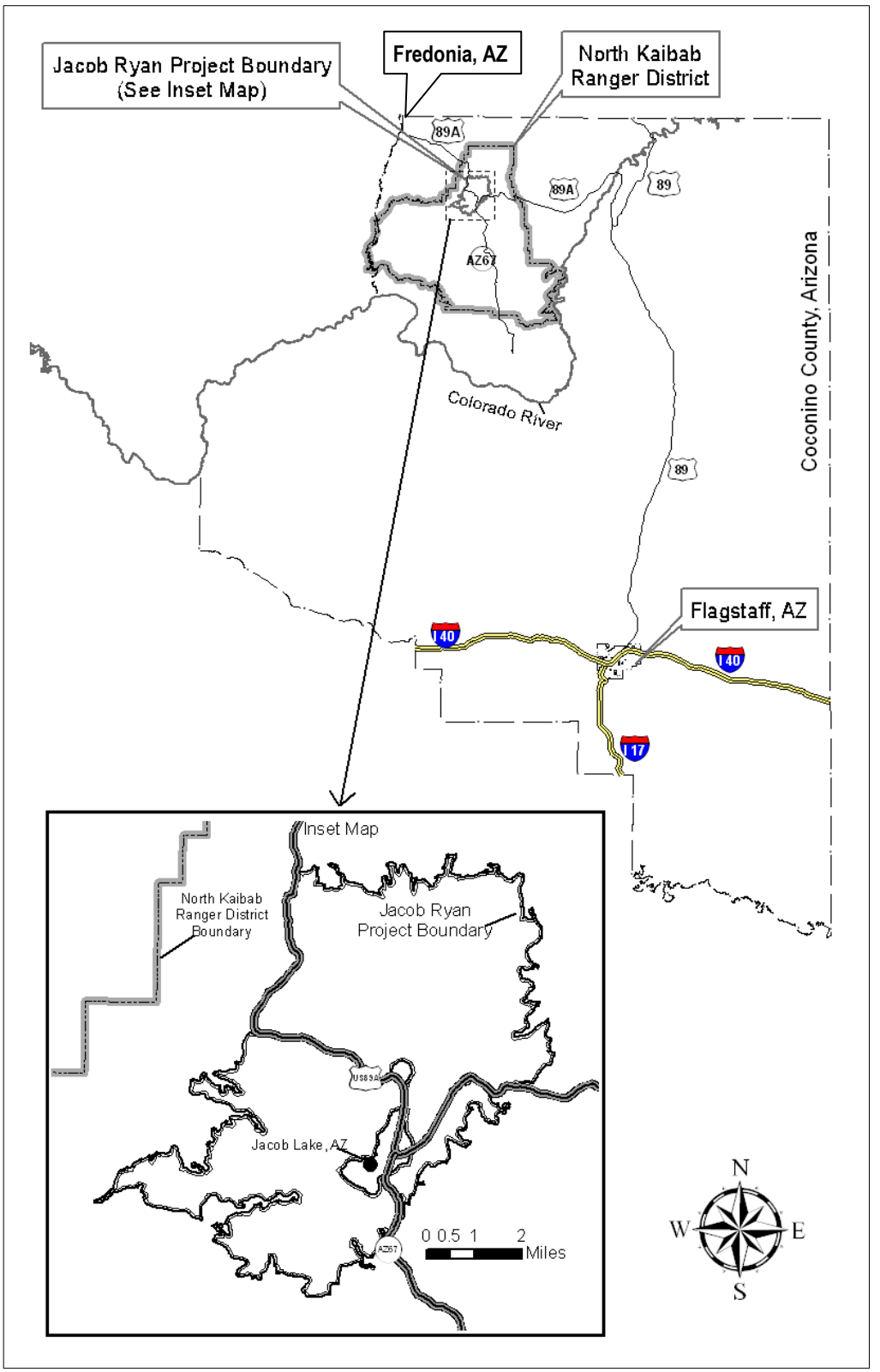

Figure 1. Jacob-Ryan Vegetation Management (JR) project location and vicinity map.

1.3 Proposed Action

1.3.1 WHO? :

The USDA Forest Service, North Kaibab Ranger District (NKRD) proposes to:

1.3.2 WHAT? :

Mechanically thin and conduct prescribed fire operations equally or evenly on approximately 25,297 acres (total) of ponderosa pine, which is considered northern goshawk habitat as defined in the Forest Plan. The project area is broken out into non-forested lands and forested lands, which is further stratified to meet analysis requirements in the Forest Plan, for Mexican spotted owl (MSO) and northern goshawk habitat as displayed in Figure 2 below. There is no designated MSO habitat within the project area, but all forested acres within the project boundary are considered northern goshawk habitat.

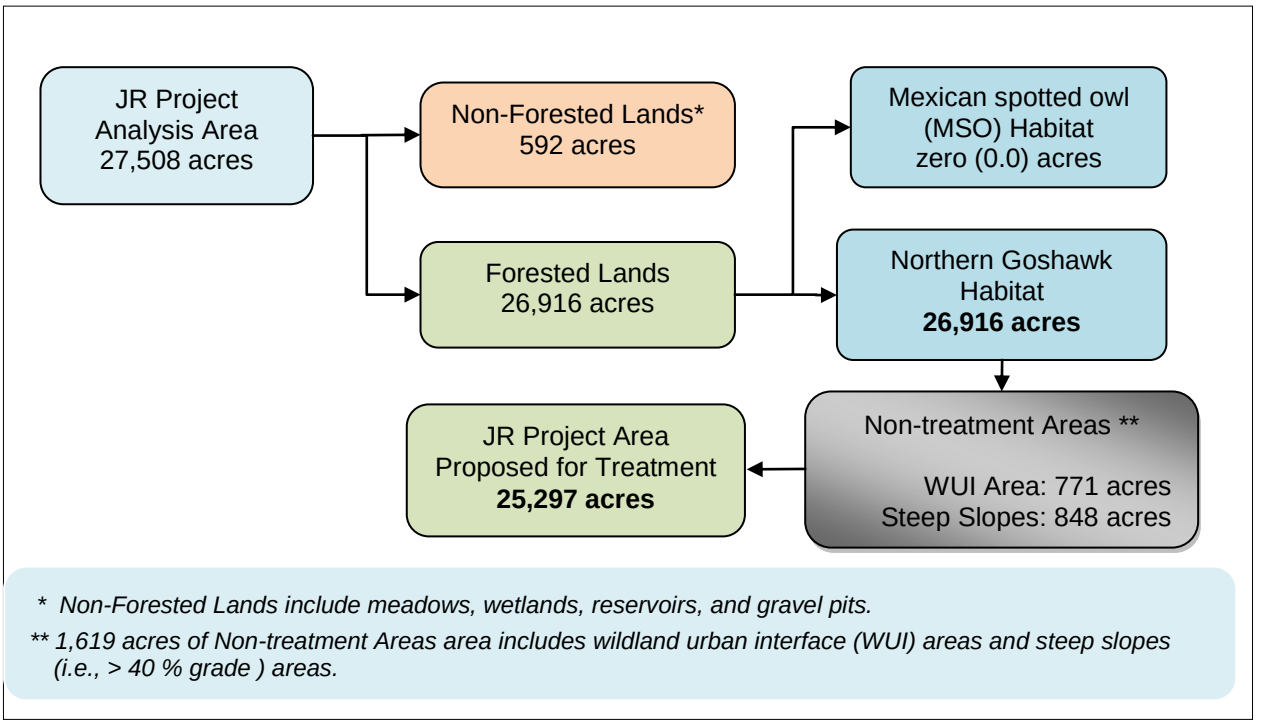

Figure 2. Stratification of forested and non-forested lands within the JR project area.

Forest stands are often classified by their forest type, by habitat type or plant associations. This project proposes to treat only the ponderosa pine cover type as described in the Forest Plan for northern goshawk habitat and the associated habitat for its prey species (See Figure 3 next page). Northern goshawk habitat is further divided into post-fledging family areas (PFA), which is the habitat most likely to be used by fledglings during early development; the six Nest Areas (30 acres each) that are within each PFA, and the areas outside PFAs called foraging areas (FAs), which goshawks use for hunting.

The project acres for the post-fledging family areas (PFAs) and foraging areas (FAs) are further stratified into Even-aged and Uneven-aged strata (See Figure 3 below). **The combined *even-aged stratum* is made up of about 160 forested stands from past shelterwood seed-tree harvest units[1] totaling *6,293 acres*.** This stratum lacks the desired forest structure and is generally considered poor goshawk nesting habitat. These even-aged stands are dominated by trees in one size class less than 12-inches in diameter, and are lacking or deficient in any defined open areas. Under the Proposed Action, even-aged forest structure would be managed towards uneven-aged forest conditions, by group selection cutting methods.

Northern Goshawk Habitat (acres) (Ponderosa pine forest)	***Nest Habitat*** *(acres)* *Existing nest (3,112)* *Replacement (1,417)* ***4,529***	
	Post-fledging Family Areas (PFA) Habitat *(acres)*	*Even-aged (acres)[1]* ***3,132***
		Uneven-aged (acres)[2] ***6,250***
		WUI (acres) ***487*** *&* *slopes > 40% (acres) +* ***428***
	10,297	*Total Non-treatment area[3] =* ***(915)***
	Foraging Area (FA) Habitat *(acres)* *(FA's = Areas Outside of Nesting areas and PFAs used for hunting prey)*	*Even-aged (acres)[1]* ***3,161***
		Uneven-aged (acres)[2] ***8,225***
		WUI (acres) ***284*** *&* *slopes > 40% (acres) +* ***420***
26,916	***12,090***	*Total Non-treatment area[3] =* ***(704)***

[1] Total Even-aged forest structure in PFA & FA = approximately 6,293 acres.

[2] Total Uneven-aged forest structure in PFA & FA = approximately 14,475 acres.

[3] Total Non-treatment in PFA and FA areas include WUI & sloped areas > 40% = approximately 1,619 acres.

Figure 3. Northern goshawk habitat stratification and acres within the JR project area.

[1] **Shelterwood-seed tree treatment** is an even-aged regeneration system designed to establish a new tree crop under a portion of the old stand, which provides both the seed source and shelter for the new seedlings. See Definitions for more details on Shelterwood seed tree treatments.

Within the ponderosa pine forest of the JR project area, the uneven-aged stratum provides higher quality goshawk habitat than the even-aged stratum, because it has three or more tree size classes and some open areas for goshawk foraging. **The combined *uneven-aged stratum* is made up of about 275 stands totaling 14,475 acres.** Under the Proposed Action, uneven-aged forest would be managed towards allocation of 40 percent of the area to mature vegetation structural stages[2] (VSS 5 and 6).

Also within the proposed JR project boundary there are steep sloped areas (greater than 40 percent) and areas proposed for fire-reduction zone types of treatment. A separate project, the Plateau Facility Fire Protection Project (PFFPP), proposes treatment of approximately 771 acres within the JR project footprint area to act as fire reduction zone or wild-fire buffer areas around structures, campgrounds, compounds, roads, trailheads and other related facilities. The majority of these planned buffer areas are considered quasi wildland urban interface (WUI) areas, and are usually located near sites along roads or highways in the Jacob Lake vicinity. Both steep sloped areas (~848 acres) and WUI areas make up non-treatment areas, which lie within both the PFA and FA habitat; under the proposed action there are no planned treatments within these areas. ***Non-treatment areas total approximately 1,619 acres.*** *(See Figure 3 and 4)*

1.3.2.1 Proposed Treatments or "Actions" Displayed by Strata:

In order to meet the intent of the Forest Plan as it relates to management of the Ponderosa pine type and northern goshawk habitat towards the desired condition of an uneven-aged forest, thinning (both mechanically and through prescribed burning) is necessary to achieve a healthier forest which is resilient to both disease and high intensity wild fire. Based on the desired conditions, as described in both the Forest Plan and northern goshawk habitat management guidelines, proposed treatments were developed which would progressively carry each strata towards the desired condition over time (i.e., from proposed project completion to 20 or more years into the future).

For a map of the treatment area broken down by habitat type, please refer to Figure 4 on the next page.

Table 1(a). Proposed Treatments within Nest Areas, Even-aged and Uneven-aged Strata.

Treatment Area by Goshawk Habitat (Map Color)	Regeneration Rx (Group selection) acres	Thinning Rx (Individual tree selection) acres	Total Treatment (All Rx's) acres
Nest Areas (Figure 4 –Red Area)	0	4,529	4,529
Even-aged stratum (Figure 4 - Orange & Purple Areas)	944	5,349	6,293
Uneven-aged stratum (Figure 4 Green & Blue Areas)	724	13,751	14,475
Grand Totals	1,668	23,629	25,297

[2] **Vegetation Structural Stages (VSS)** for ponderosa pine, mixed conifer and spruce-fir forests per the Forest Plan standards and guidelines is 10% grass/forb/shrub (VSS1), 10% seedling-sapling (VSS2), 20% young forest (VSS 3), 20% mid-aged forest (VSS4), 20% mature forest (VSS 5), 20% old forest (VSS6). Except for canopy cover, the VSS distribution and structural conditions are the same within and outside the post-fledgling family area. NOTE: The specified percentages are a guide and actual percentages are expected to vary + or – up to 3%.

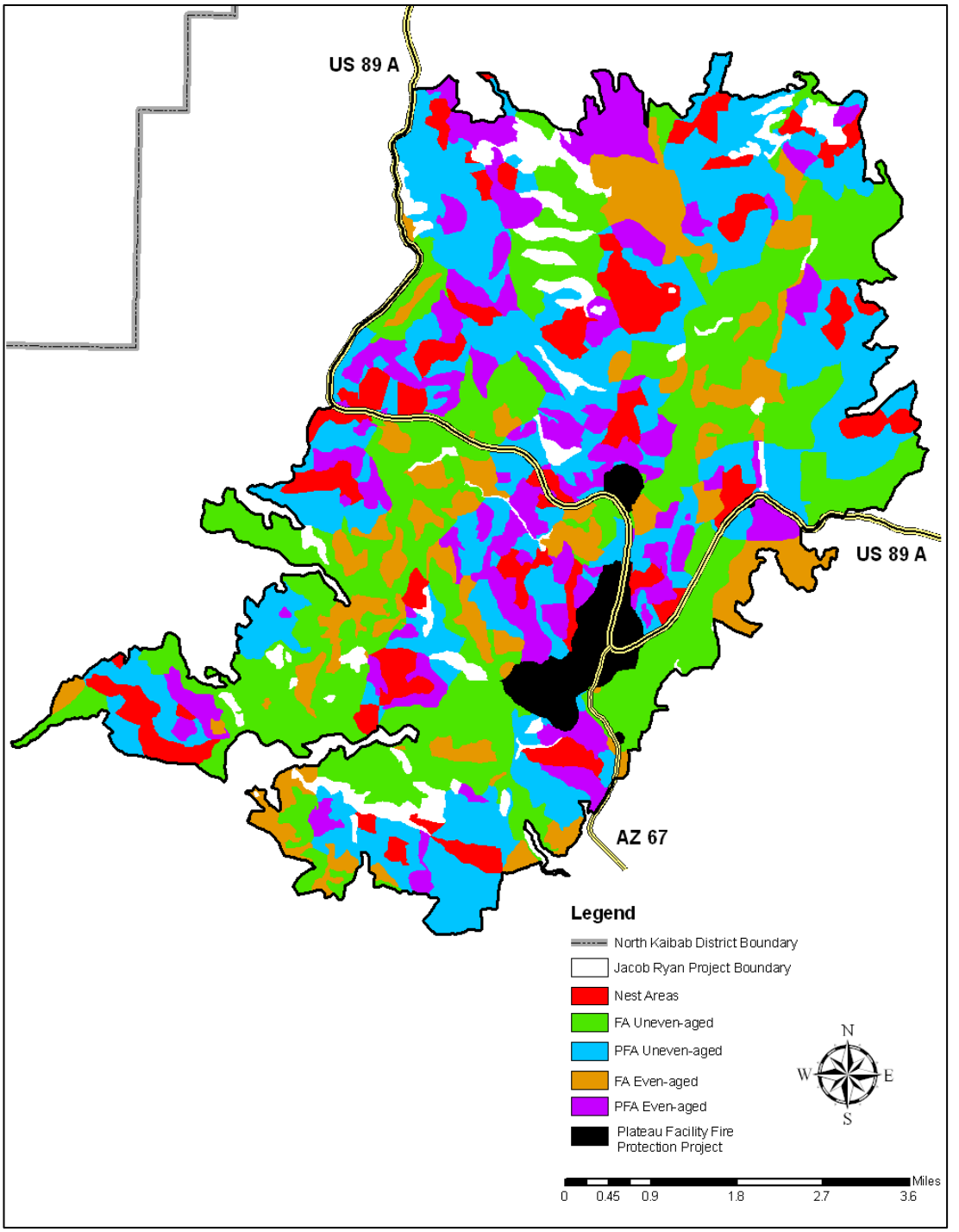

Figure 4. - JR proposed treatment locations by the individual northern goshawk habitat strata

(Note: Individual colors or shading define the locations for Nest Areas, Uneven-aged and Even-aged strata within the goshawk FAs and PFAs. Map areas within the JR boundary in "white" are not being treated because they are meadows, steep slopes greater than 40 percent, or vegetation other than ponderosa pine. Map areas in "black" are part of the Plateau Facility Fire Protection Project that are made up of developed recreation sites, private in-holdings and government facilities within the project area and are not being treated under this proposal.)

The following is a listing of proposed treatments or actions within the JR project area by goshawk habitat strata [i.e., Nest Areas, Foraging Areas and Post-Fledgling Areas within Even-aged strata, and Foraging Areas and Post-Fledgling Areas within Uneven–aged strata, which are portions of the ponderosa pine forest type; acreages are approximate and consistent with Figures 2 – 4 and Table 1(a), above]:

- ***Actions in the "Nest Areas" Habitat Strata (~ 4,529 acres)***

  [Correlates with "Red" shaded area as indicated on Figure 4]

  1. Mechanical tree thinning

  a. Thin from below [up to 12-inches in diameter at breast height (DBH)] in goshawk nest areas (3,112 acres) and replacement nest areas (1,417 acres) to aid their development towards a structure of large trees, which includes interlocking crowns, with emphasis on reducing fuel ladders and fuel loads, and not on regenerating groups

  b. Retain canopy cover of 50-70 percent at the group level (VSS 5-6) in nest areas (Forest Plan, pg 30)

  c. Remove dwarf-mistletoe infected trees to eliminate infection source, or isolate infected trees as needed for wildlife habitat and future snags

  d. Retain snags, downed logs and woody debris per Forest Plan Standards and Guidelines (S&Gs) (Forest Plan, pg 29)

  2. Prescribed burning

  a. Prescribe burn nest area habitat on 4,529 acres in coordination/conjunction with even-aged and uneven-aged stands

  b. Hand-pile slash and conduct pile burning operations as needed prior to prescribed burning in those areas where surface fuel loads exceed 15 tons per acre

- ***Actions in the "Even-aged" Strata for both PFA and FA Habitat Area (~ 6,293 acres)***

[Correlates with "Purple" & "Orange" shaded areas respectively, as indicated on Figure 4]

  3. Mechanical tree thinning

  a. Thin trees by cutting, using basal area as a guide to reduce stand density to 50-90 square feet per acre, in such a way as to create a clumped/grouped spatial arrangement of forest vegetation on 6,293 acres

  b. Thin to the desired stand density in even-aged stands that have only one size class. [Regenerate 15% of this strata, or approximately 944 acres, by cutting trees in groups, in stands with remaining overstory seed trees, thereby creating openings from 1/4 acre up to 4 acres in size, with a maximum width of 200 feet, where ponderosa pine would regenerate.]

  c. Remove dwarf-mistletoe infected trees to eliminate infection sources or isolate infected trees as needed for wildlife habitat and future snags

  d. Retain all healthy seed trees remaining from previous shelterwood seed cuts

  e. Retain snags, downed logs and course woody debris (CWD) per Forest Plan S&Gs (pg 29), current and expected amounts can be found in Vegetation Resource Specialist Report (2010 PR-29)

  f. Treat and manage slash to retain the desired target of 5-7 tons per acre after thinning and prescribed burning

- ***Actions in the "Even-aged" Strata for both PFA and FA Habitat Areas (continued)***

Mechanical tree thinning (continued)

g. Lop and scatter activity slash from current thinning treatments or thin sub-merchantable material, without follow-up burning, to increase levels of coarse woody debris where they are currently deficient [ecological map units[3] (EMUs) 620 & 624 = 338 acres]

4. Prescribed burning

a. Prescribe burn even-aged stands in coordination/conjunction with uneven-aged stands and nest area habitat on 5,955 acres. (Total even-aged forest structure 6293 acres, less 338 acres of EMUs 620 & 624 that are excluded from burning = 5955 acres)

b. Pile slash and conduct pile burning operations as needed prior to prescribed burning in those areas where surface fuel loads exceed 15 tons per acre

c. When prescribed burning, protect as many of the healthy seed trees as feasible that were retained in thinning operations (it is reasonable to expect 95 percent or more of seed trees to survive prescribed burning, based on historical experience conducting prescribed burns on the district)

- ***Actions in the "Uneven-aged" Strata for both PFA & FA Habitat Areas (~ 14,475 acres)***

[Correlates with "Aqua Blue" & "Green" shaded areas respectively, as indicated on Figure 4]

5. Mechanical tree thinning

a. Select and regenerate tree groups in the different vegetative structural stages (VSS) in such a way as to change VSS distribution toward 10/10/20/20/20/20 for VSS 1-6 on a percentage by area basis. Conduct thinning in such a way as to create a clumped/grouped spatial arrangement of residual trees on 14,475 acres

b. Regenerate areas totaling about 1 percent of the total area of this stratum from VSS 4 (mid-aged trees, now at 23 percent), 3 percent of the total area of this stratum from VSS 5 (mature trees, now at 23 percent), and 1 percent of the total area of this stratum from VSS 6 (older trees, now at 21 percent), thereby creating new areas of VSS 1 (now deficit – about 724 acres) (See page 17, Chapter 2, Alternative 1, 2nd paragraph)

c. Cut trees in groups, thereby creating openings from 1/4 acre up to 4 acres in size (openings will generally be less than 1 acre in size), with a maximum width of 200 feet, where ponderosa pine would regenerate

d. Retain a group of 3-5 healthy reserve trees in created openings greater than 1 acre

e. Remove dwarf-mistletoe infected trees to eliminate infection source or isolate infected trees as needed for wildlife habitat and future snags

f. Retain snags, downed logs and woody debris per Forest Plan S&Gs (pg 29)

g. Treat and manage slash to retain the desired target of 5-7 tons per acre after thinning and prescribed burning

[3] Ecological map units (EMUs) are identified as map units in the Terrestrial Ecosystem Survey of the Kaibab National Forest, Brewer et al. 1991, which provided the basis for conducting the soil assessment.

- ***Actions in the "Uneven-aged" Strata for both PFA and FA Habitat Areas (continued)***

Mechanical tree thinning (continued)

h. Lop and scatter activity slash from current thinning treatments or thin sub-merchantable material, without follow-up burning, to increase levels of coarse woody debris where they are currently deficient (EMUs 293, 620 & 624 = 928 acres)

i. Reduce high stand densities in PFAs (6,250 acres) to approximately 70-90 square feet of basal area[4] per acre (BA), and a Stand Density Index (SDI)[5] between 135 to 190 (initial analysis was between 110-160), or 30 to 40 percent of maximum SDI (See 2nd paragraph under section 2.1 and table 4 below).

j. Retain 50-60 percent canopy cover at the group level in PFAs (VSS 4, 5, 6)

k. Reduce high stand densities in FAs (8,225 acres) to approximately 55-80 square feet of BA per acre (initial analysis 50-70), and an SDI between 112 to 180 (initial analysis between 90 and 110), or 25% - 40% of maximum SDI (See 2nd paragraph under section 2.1 and table 4 below).

l. Retain canopy cover of 40 percent or more at the group level in FAs (VSS 4, 5, or 6)

6. Prescribed burning

a. Prescribe burn uneven-aged stands on 13,547 acres in coordination/conjunction with even-aged stands and nest area habitat (EMUs 293, 620 & 624 are excluded from burning = 928 acres)

b. Pile slash and conduct pile burning operations as needed prior to prescribed burning in areas where surface fuel loads exceed 15 tons per acre

c. When prescribed burning, protect as many healthy seed trees as feasible that were retained in thinning operations (it is reasonable to expect 95 percent or more of seed trees to survive prescribed burning, based on historical experience conducting prescribed burns within the district)

1.3.3 WHERE? :

The JR Project area lies in the north-central portion of the Kaibab Plateau on the North Kaibab Ranger District, Kaibab National Forest; Coconino County, Arizona. The timber stands are located on both sides of U.S. Highway 89A (See Figures 1 and 4). U.S. Highway 89A and Arizona Highway 67 pass through the project area. Highway 67 runs south from its junction with U.S. Highway 89A and is the main access route to the North Rim of Grand Canyon National Park.

The JR project area lies within Geographic Area (GA) 13 of the Kaibab National Forest, the Grand Canyon National Game Preserve, the Kaibab Squirrel National Natural Landmark, and Arizona Game and Fish Game Management Unit 12A.

A general legal description of the Jacob Ryan (JR) Vegetation Management project area is all or portions of T38N, R1E, Sections 1-4, 8-18, 22-25; T38N, R2E, Sections 3-9, 17-19; T39N, R1E, Sections 11-14, 23-27, 33-36, and T39N, R2E, Sections 4, 7-10, 14-23, 26-35, of the Gila and Salt River Baseline and Meridian.

[4] **Basal area** is a summation of the cross-section areas of all trees in a stand on a per acre basis. The formula to determine basal area per tree is: B.A. = .005454 x Diameter^2 Larger trees, for example, have greater basal area.

[5] **Stand Density Index (SDI)** is a measure of relative stand 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 per acre. The onset of self-thinning or competition-induced mortality occurs when SDI is at 57 percent of maximum potential site occupancy.

1.3.4 WHEN? :

A decision for this project, based on this EA, is expected to be made in January, 2012. If a decision is issued at such date, project implementation or activities regarding actual field operations could possibly begin in early calendar year 2012. Most prescribed burning treatments would be conducted after proposed mechanical thinning treatments. However, on suitable sites, prescribed burning may be conducted before thinning or in lieu of thinning. Prescribed burning treatment(s) will only take place after approval of either a site specific or project burn plan. The proposed JR project, if carried forward to approval, would take place over the next seven (7) years or more, contingent on future budgeting, ability to mobilize contracts/contractors (workforce & seasonal conditions on the NKRD), and capacity and timing necessary to meet objects or milestones associated with the project treatment areas.

1.4 Purpose and Need for Action

The proposed project follows the goals and objectives of the Kaibab National Forest Land and Resource Management Plan (Forest Plan 1988, as amended) toward achieving Forest Restoration that facilitates forest ecosystem sustainability by changing the structure of even-aged stands toward uneven-aged. Thinning and regeneration cutting in the uneven-aged strata would move the area distribution of Vegetative Structural Stages (VSS) toward a recommended goal of 10-10-20-20-20-20 percent for VSS 1-6, respectively, to maintain and improve forest sustainability and to provide improved habitat for northern goshawks and their prey species.

The Proposed Action follows the management direction in the Forest Plan[6], which includes the management of the forest and its resources using the best methods available to meet the needs and desires of present and future generations, while protecting and enhancing the environment. The overall goal of management of the forest emphasizes a long range improvement of land productivity, while protecting and enhancing the resource values. Reductions in stand density and disease levels would improve, maintain, and enhance forest health. Proposed thinning and regeneration cutting require the retention of live reserve trees, snags, downed logs and woody debris throughout the ponderosa pine forest type (which is both a long range improvement goal, as well as a landscape level management goal regarding ecosystem management in northern goshawk habitat).

1.4.1 WHY HERE? :

A healthy forest is one that is ecologically sustainable and acts as habitat for native plant and animal species. In terms of the Jacob-Ryan project area, this means preserving the function of the ponderosa pine type forest which is habitat for northern goshawk and its prey species; a healthy forest is to be managed as a dynamic condition towards an uneven-aged stratum within the PFA and FA habitat. The density of trees within the uneven-aged stratum (within the PFAs and FAs) in the JR project area is approximately twice the desired level it should be.

Current Stand Density Indexes (SDI) or trees per acre within the JR project area range between 245 and 295. The onset of self-thinning or competition-induced mortality occurs when the SDI exceeds 257, which is 57 percent of maximum site occupancy of 451 trees per acre (Long et al. 2004). There is a need to reduce high stand densities in approximately 6,250 acres of Post-Fledgling areas to approximately 70-90 square feet of basal area[7] (BA) per acre, and a SDI of approximately 135 to 190 (initial analysis levels for SDI were between 110-160), or 30% - 40% of maximum SDI (See second paragraph of section 2.1 and

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[6] **Forest Plan**; "*Ecosystem Management in Northern Goshawk Habitats*" Standards & Guidelines; (Table 12 - p.21; pp 27-34, & 34-1).

[7] **Basal area** is a summation of the cross-section areas of all trees in a stand on a per acre basis. The formula to determine basal area per tree is: B.A. = .005454 x Diameter^2 Larger trees, for example, have greater basal area. [Also see *Terms and Definitions* section]

table 4 below). The current condition within the proposed JR project area jeopardizes forest health and perpetuates the high risk of uncharacteristic crown fire within the unbroken tree canopy.

Current high fire hazards based on existing stand densities and fuel loading in both strata (uneven-aged and even-aged) could actually facilitate the transition of surface fires into the upper canopy, thus helping create destructive crown fires. Some of the values "at risk" due to high stand density and crown fires include forest health, desired forest structure, wildlife habitat and watershed function. The reduction or loss of these values will weaken or destroy the functionality of the forest ecosystem.

All areas proposed for treatment can be adequately accessed by the existing road system. This project would use only existing roads, no new roads will be created.

Other than the Willis Fire which occurred in 1987, there have been no large fires within the JR project area in the last 25 years (See Figure 5 below). The Warm Fire area (2006) is located south of the JR project area and also lies within Geographic Area 13. The ponderosa pine needs low intensity, high frequency (every two to twenty years; ERI 2011) fire in order to become a more natural fire adapted ecosystem. The JR project would be the first step towards returning over 25,000 acres to this type of a naturally maintained system. Without the JR project and the creation of regeneration openings, the project area will be at a higher risk to high intensity stand replacing fires, both from within and from outside the project area.

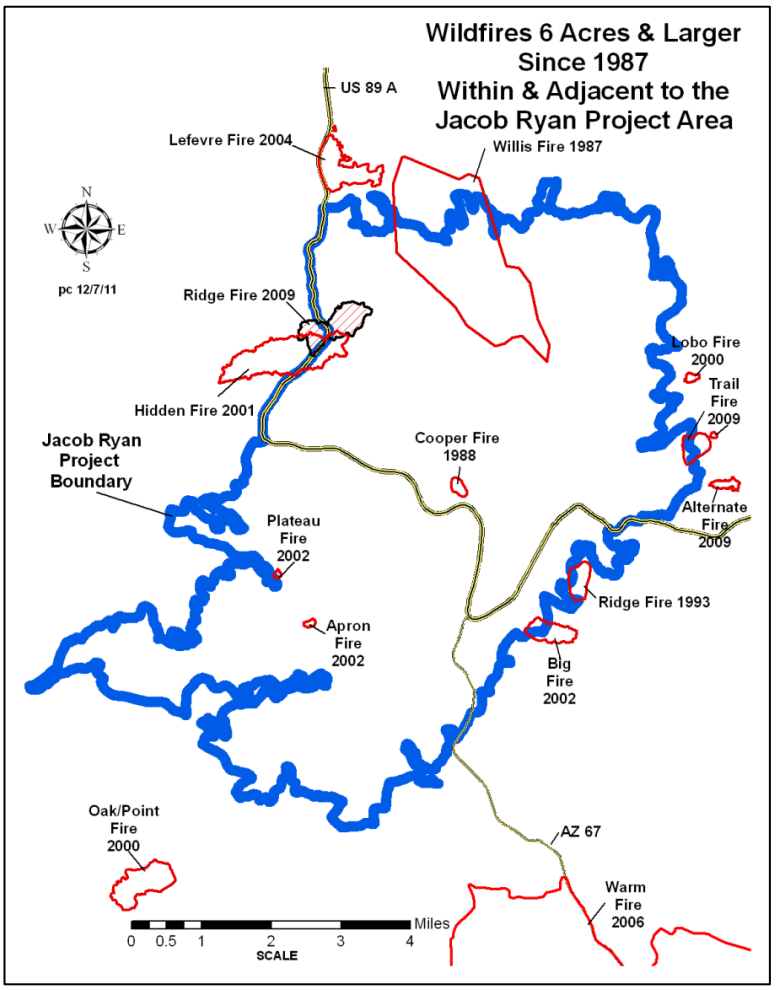

Figure 5. – Wildfires within and adjacent to the JR project area since 1987.

1.4.2 WHY NOW? :

Objectives under Forest Service directives are to reestablish and retain ecological resilience of National Forest System lands and associated resources to achieve sustainable management and provide a broad range of ecosystem services. Healthy, resilient landscapes will have greater capacity to survive natural disturbances and large scale threats to sustainability, especially under changing and uncertain future environmental conditions, such as those driven by climate change and increasing human uses. (USDA Forest Service, March 2010).

The existing dense forested condition within the JR project area is creating competition between trees for water and nutrients, thus hindering optimal growth and forest health, while creating excess fuel loads and ladder fuels. This increases the likelihood that when wildfires occur, that they have a higher potential of turning into high-intensity, stand-replacing fires, just like those that occurred within the Warm Fire area, located just south of this project area. (See Figure 6 below).

Figure 6. – Picture of Warm Fire area (from cover of Final Environmental Impact Statement for the Warm Fire Recovery Project, March 2009)

Factors other than environmental effects, which are also important to consider in management of the forest as a resource, include risk management (i.e., the project area's susceptibility to potential high intensity wildfire). Many recent news articles have stated that due to an overly dense ponderosa pine forest, and a lack of self-regulating low-intensity wild fires, that fires now have a tendency to become crown fires and burn within the tree-tops or canopy area of the forest (Covington, Wally. June 2011.) In this news article Covington expressed the following:

> "In the overly dense ponderosa pine forests, where fire once burned naturally along the forest floor every two to 10 years—killing excess tree seedlings, recycling nutrients and removing the dead and dying debris—it is now burning through the treetops."

Western governors have also recently called for more thinning and collaboration to improve forest health (Reese, April. June 2011) Decades of excluding fire in the Western states have resulted in densely packed stands and a buildup of forest-floor fuels in many dry forests, which can lead to large, continuous crown fires when wildfires do occur. Crown fires are of particular concern to forest managers because they are challenging to suppress and are capable of causing widespread mortality in stands.

This year, Arizona and New Mexico have already experienced the worst fires in the states' histories. The importance of thinning was illustrated by the recent Wallow fire in Arizona, which burned 538,000 acres. (USDA Forest Service, August 2011)

As stated in the section 1.4.1, above, some of the values "at risk" include forest health, desired forest structure, wildlife habitat and watershed function. The risk can be reduced and the forest health can be protected (both short-term and into the future) and made more sustainable through implementation of thinning and/or regeneration projects, such as the Jacob-Ryan Vegetation Management project.

1.4.3 PURPOSE AND NEED BASED ON FOREST PLAN & PROPOSED ACTIONS

The following Purpose and Need statements are based on the Forest Plan, as they relate to the desired conditions per standards, guidelines, goals, and/or recommendations of the Forest Plan and northern goshawk guidelines**.** Below are listed the "Purpose and Need" statements by goshawk habitat strata: (i.e., Nest Areas, Post-Fledgling Areas & Foraging Areas within Even-aged, and Post-Fledgling Areas & Foraging Areas within Uneven-aged portions of the Ponderosa pine forest type. – See Figure 4)

Please refer to pages 7 through 9 above for corresponding proposed actions to as they relate to the purpose and need statements under the bulleted items below.

- ***Actions 1a through 1d in "Nest Areas" Habitat Strata (Mechanical tree thinning):***
  - To improve nesting habitat for northern goshawks by moving stand structure toward dense uneven-aged conditions with large, old trees and high canopy cover (thin from below with non-uniform spacing)
  - To reduce ladder fuels, thus helping to prevent surface fires from transitioning into crown fires (thinning)
  - To comply with Forest Plan S&Gs by retaining snags, downed logs and woody debris, some of which are currently deficient in nest areas (See Table 3)
  - To limit spread of dwarf-mistletoe by limiting mistletoe distribution and severity to endemic levels[8] (removal or isolation of infected trees)
  - To forestall insect infestations and limit spread of forest diseases (thinning)

- ***Actions 2a through 2b in "Nest Area" Habitat (Prescribed burning):***
  - To promote forest health and reduce the potential for undesirable wildfire effects (through prescribed burning)
  - To prevent soil impacts from prescribed burning in areas with 15 tons or more of fuel loading per acre (hand piling slash and burning piles before prescribed burning)
  - To reduce surface fuel loads to a more manageable 5-7 tons per acre from average existing fuel loads of 8-18 tons per acre (prescribed burning, or piling slash and burning piles as needed before prescribed burning , when fuel loads exceed 15 tons per acre)
  - To increase understory grass, forb, and shrub production (through prescribed fire, after thinning)

- ***Actions 3a through 3g in Even-aged PFA and FA Habitat Areas (Mechanical tree thinning):***
  - To improve forest health and tree growth by reducing competition (thinning)
  - To manage toward desired stand density in even-aged stands that have only one size class (i.e., by cutting smaller diameter trees)

[8] Endemic is a quality or status that is native or confined to a certain region and having a comparatively restricted distribution; often said of a disease that is generally considered low or under control, while the overall population trend is stable or steadily increasing.

- To change the structure of even-aged stands [Table 1(b)] toward uneven-aged, by creating openings for regeneration under remaining overstory seed trees (cutting small trees in groups)

Table 1(b). Existing percent of distribution for Even-aged PFA and FA goshawk habitat.

Desired VSS Distribution VSS Size Class / (Percentage of Acres) & Size	Even-aged PFA & FA Goshawk Habitat (Percentage of stand level)
1 & 2 – (20 % combined) 0 - 4.9 inches	**63 %**
3 – (20 %) 5 – 11.9 inches	**37 %**
4 – (20 %) 12 – 17.9 inches	Zero
5 – (20 %) 18 – 24 inches	Zero
6 – (20 %) 24 inches +	Zero

- To reduce ladder fuels as one means of preventing surface fires from transitioning into crown fires (reduction of ladder fuels as part of thinning)
- To assist in preventing surface fires from transitioning into crown fires (creating openings by cutting groups of small trees under remaining overstory seed trees)
- To comply with Forest Plan S&Gs by retaining snags, downed logs and woody debris, all of which are currently deficient in the even-aged strata (Table 3)
- To improve long-term productivity of specific soil units by increasing coarse woody debris and maintaining it at a desired level of 5-7 tons per acre (lopping and scattering slash and thinning sub-merchantable material without follow-up burning)
- To limit spread of dwarf-mistletoe by limiting mistletoe distribution and severity to endemic levels (removal or isolation of infected trees)
- To forestall insect infestations and limit spread of forest diseases (thinning)
- To help the forest be more resilient and adaptable to environmental stressors such as drought, insect epidemics and climate change (thinning to increase the vigor of residual trees)

➢ ***<u>Actions 4a through 4c in Even-aged PFA and FA habitat areas (Prescribed burning):</u>***

- To promote forest health and reduce the potential for undesirable wildfire effects (through prescribed burning)
- To prevent soil impacts from prescribed burning in areas with 15 tons or more of fuel loading per acre (piling slash and burning piles before prescribed burning)
- To provide manageable surface fuel loads at 5-7 tons per acre by augmenting the existing fuel loads where deficit (lopping and scattering slash and thinning sub-merchantable material without follow-up burning)
- To increase understory grass, forb, and shrub production (use of prescribed fire after thinning)
- To facilitate regeneration of openings (retaining and protecting healthy seed trees)

➢ ***<u>Actions 5a through 5l in Uneven-aged PFA and FA habitat areas (Mechanical tree thinning):</u>***

- Manage to move the existing VSS area distribution toward the Forest Plan's desired condition of 10-10-20-20-20-20 (thinning and regeneration) (See Table 2 below)

Table 2. Existing VSS percent of distribution and acres for Uneven-aged PFA and FA habitat.

Desired VSS (Percent of Acres) ~ Diameter Range	Existing Uneven-aged Percent (tree group-level VSS)	Post-Fledging Family Area Habitat Acres	Foraging Area Habitat Acres
VSS 1 (10) 0 – 0.9 inches	5	356	411
VSS 2 (10) 1 – 4.9 inches	10	513	946
VSS 3 (20) 5 – 11.9 inches	18	1,169	1,374
VSS 4 (20) 12 – 17.9 inches	23	1,238	2,073
VSS 5 (20) 18 – 24 inches	23	1,569	1,818
VSS 6 (20) 24 inches +	21	1,406	1,604
Totals	**100**	**6,250**	**8,225**

- To recruit new areas of VSS 1 which are now deficit with about 5 percent regeneration, as shown in proposed actions (item 5 b. – pg. 8) to achieve the desired 10 percent (cutting trees in groups thereby creating openings in which ponderosa pine can regenerate to maintain desired condition)
- To improve forest health and tree growth by reducing competition (thinning)
- To reduce ladder fuels and increase canopy base height from almost 8 feet to over 25 feet after treatment, which would help keep wildfires on the ground (thinning)
- To assist in preventing surface fires from transitioning into crown fires (cutting trees in groups, thereby creating openings and reducing canopy continuity)
- To comply with Forest Plan S&Gs by retaining snags, downed logs and woody debris, which may be deficient in the uneven-aged strata (Table 3)

Table 3. Existing condition for snags, downed logs and woody debris by strata in Jacob-Ryan.

Forest Plan Stand Desired Condition	Even-aged per acre	Uneven-aged per acre
Snags (2 per acre, 18” DBH* & 30’ tall)	< 1 snag per acre	1.1 snags per acre
Downed Logs (3 / acre >12” DBH & 8’ long)	~ 2 per acre	~ 3 per acre
Woody Debris (5-7 tons / acre, 3” or greater on forest floor)	~ 3-7 tons per acre	~ 8-18 tons per acre
*DBH = “diameter at breast height,” which is the diameter of a tree approximately 4.5 feet above ground level.		

- To improve long-term productivity of specific soil units by increasing coarse woody debris and maintaining it at a desired level of 5-to-7 tons per acre (lopping and scattering slash and thinning sub-merchantable material without follow-up burning)

- To limit spread of dwarf-mistletoe by limiting mistletoe distribution and severity to endemic levels (removal or isolation of infected trees)
- To avert insect infestations and limit spread of forest diseases (thinning)
- To reduce the risk of crown fires burning into goshawk nest areas from adjacent areas (cutting trees in groups, thereby creating openings, in areas adjacent to goshawk nest areas, i.e. in PFAs and FAs)
- To comply with Forest Plan S&Gs for canopy cover percentages by habitat area (thinning)
- To help the forest be more resilient and adaptable to environmental stressors such as drought, insect epidemics and climate change (thinning to increase the vigor of residual trees)

➢ ***Actions 6a through 6c in Uneven-aged PFA and FA habitat areas (Prescribed burning):***

- To promote forest health and reduce the potential for undesirable wildfire effects (through prescribed burning) [Action 6a]
- To prevent soil impacts from prescribed burning in areas with 15 tons or more of fuel loading per acre (piling slash and burning piles before prescribed burning)
- To reduce surface fuel loads to a more manageable desired 5-7 tons per acre from the average existing fuel loads of 8-18 tons per acre (prescribed burning, or piling slash and burning piles as needed before prescribed burning when fuel loads exceed 15 tons per acre)
- To increase understory grass, forb, and shrub production (use of prescribed fire after thinning)
- To facilitate regeneration of openings (retaining and protecting healthy seed trees and preparing seedbed conditions conducive for regeneration)

1.5 Other Considerations

There are approximately 771 acres that are part of the proposed Plateau Facility Fire Protection Project (PFFPP),[9] consisting of developed recreation sites, and private in-holdings and government facilities within the project area, that are considered wildland-urban interface (WUI) areas which are not proposed for treatment in this project (Figure 4). Proposed treatments also avoid and stay out of about 592 acres of non-forested lands (Figure 2) along with 848 acres of steep slopes (Figure 3). Prescribed burning is deferred on 1,266 acres [see proposed actions 4(a) & 5(h) on pages 7 and 8 above] within EMUs 293, 620 and 624, which results in net treatment acreage of 25,297 acres of thinning and/or 24,031 acres of prescribed burning. Thinning and burning treatments do overlap each other. PFFPP is included and evaluated in the cumulative effects section of this EA.

1.6 Decision to be Made (Decision Framework)

The Forest Service is providing this environmental analysis to determine the effects of this proposal and its alternatives. Only one decision document will be issued. Based on the Proposed Action (i.e., improvement of northern goshawk habitat and to improve forest health) and the scoping that was completed in June-July, 2010, the Forest Service made minor modifications to the Proposed Action (i.e., the Modified Proposed Action – Alternative 1) and initiated a 30-day public review period of the Preliminary EA for JR between June 20 – July 19, 2011. Upon completion of reviewing, evaluating, and considering the comments received from the 30-day public review of the Preliminary EA (see Appendix D), the **Responsible Official will decide:** **1)** whether to select and implement Alternative 1 – the Modified Proposed Action as described within this document, **or** **2)** whether to implement the other action

[9] Note: This project has undergone a public scoping period and is currently undergoing internal environmental analysis for the preparation of a Draft Enviironmental Assessment, and is potentially scheduled to be implemented in early 2012)

alternative (Alternative 3) to this proposal, that was developed based on public comment/scoping issues, and/or other sensitive issues, **or 3)** whether "not" to take any action on the proposed project at this time (i.e., Alternative 2 – the "No Action" Alternative). A decision on this project is expected by January 2012, and if appealed, a final ruling should be made by early calendar year 2012.

1.7 Public Involvement

The District Ranger sent a scoping letter and notice of the Proposed Action, dated June 2, 2010, to interested members of the public, various government agencies, tribal organizations, permittees, environmental organizations and the timber industry. A legal notice was published in the Arizona Daily Sun, Flagstaff, Arizona, on June 2, 2010 notifying the public of the project proposal and how to comment. A press release was sent to local newspapers on June 4, 2010 that provided a Forest Service website describing the project and how to comment. Of the 185 letters mailed, five (5) responses were received totaling 27 comments. Eleven (11) "*non-issue*" comments were received, which were mostly comments in support of the Proposed Action (6 comments) or comments that did not clearly disagree with the Proposed Action or were not specific to the Proposed Action (5 comments). In addition, there were another six (6) "*non-issue*" comments that only raised alternatives to be considered, without identifying any clear disagreement with the Proposed Action. This left ten (10) comments or issues which were potential "*Scoping Issues*" to be looked at and evaluated. See Scoping Issues, next section.

1.8 Scoping Issues

A number of Scoping comments raised alternatives to be considered. Most of these alternatives were eliminated from detailed study because either they were already decided by the Forest Plan, or they overlap or duplicate the Proposed Action, or are clearly unreasonable or fail to meet the purpose and need. The alternatives considered, but eliminated from detailed study, along with the alternatives to be studied in detail, are discussed in Chapter 2 of this EA and in the *Jacob-Ryan Public Scoping Comment Summary*[10] (PR-26), which is hereby incorporated by reference and available on request.

The remaining ten (10) comments received from the June-2010 Scoping of the Proposed Action, were potential issues because they presented a point of debate, dispute, or disagreement regarding anticipated effects of the Proposed Action. Nine (9) of the 10 issues were determined to be "*non-important*" because they were considered to be: outside the scope of the Proposed Action; already decided by law, regulation, Forest Plan or other higher level decision; irrelevant to the decision to be made; or conjectural and not supported by scientific or factual evidence. This process, used by the inter-disciplinary team of resource specialists, helped in identifying the key issues that modified the proposed actions or was a driver in selection of the alternatives to the proposed action. This resulted in one remaining Scoping issue that needed to be addressed or evaluated further, which is discussed in further detail in the next section of this EA. The Effect Analysis documented in Chapter 3 of this EA provides information and analysis that is responsive to scoping comments that raised questions or concerns about the effects of the project.

[10] Gatto, A. 2010. The Jacob-Ryan Public Scoping Comment Summary. USDA Forest Service, North Kaibab Ranger District, Fredonia, AZ 86022 (PR-26)

1.9 Important Issues & Development of the Modified Proposed *Action*

The only remaining issue, which was found to be "*important*," was from the Center for Biological Diversity, saying that "*...soils exhibiting unsatisfactory or impaired conditions…would experience disturbance to varying degrees…"* The portion of this issue pertaining to Ecological Map Unit 9 is an important issue that is addressed by the Modified Proposed Action, as described at the beginning of Chapter 2.

Ecological Map Unit (EMU) 9 is identified as being in unsatisfactory soil condition. Surface soil structure and aggregation has deteriorated and is considered a major factor in the degradation of the surface layer or A-horizon. Common expressions of deteriorated surface A-horizon include the loss of organic matter in the form of humus, reduction of pore space, the closing of soil pores and the development of platy and massive soil structure at or near the soil surface. The overall effect is a reduction in water infiltration and a reduction in the production of deep rooted, perennial bunch grasses resulting in decreased vegetative ground cover especially the litter component. Litter is the primary component in vegetative ground cover. Evidence of past gully erosion, with some gullies more pronounced than others, suggests that these soils may be currently experiencing drier soil moisture conditions. This is evident in the existing plant community where changes in the vegetation composition indicate a shift towards a drier, less productive, plant community. This is also evidenced by a reduction in deep rooted, perennial bunch grasses (i.e. fescues and muhlys) and the presence of shallow-rooted grasses (i.e. blue grama and the exotic Kentucky bluegrass). Ponderosa pine is also encroaching and has become established within areas of this ecological map unit. Unsatisfactory soil condition indicates that the inherent productive capacity of the soil resource is not being sustained with respect to the hydrologic function of the soil. There are ***356 acres*** within the JR project of unsatisfactory soil condition within this grassland ecosystem (Soil and Watershed Report, 2011 PR-32).

In response to the important issue of poor or unsatisfactory soils conditions within the EMU 9 area. The Interdisciplinary Team assigned to the development of this EA made a minor modification to the Proposed Action to reduce disturbance to soils in Ecological Map Unit 9. [See Soil and Watershed Section 3.2.3 for detailed discussion of effects to Ecological Map Unit 9.]

[note: This is clarification regarding other "potential" key issues: such as conserving all trees greater than 16-inches DBH; retaining old forest structure (i.e., trees older than 130 years of any size); conserving all trees greater than 12-inches DBH in even aged stands; importance of maintaining "old forest" character; and removal of trees infected with dwarf mistletoe, which were considered but did not generate additional alternatives to be carried forward into the detailed study of alternatives (except for the 16-inch diameter cap). The current Forest Plan contains specific standards and guidelines that address all of these issues when it comes to vegetation management projects within the ponderosa pine type forest and northern goshawk habitat. Specifically, the Forest Plan addresses Vegetation Stage Structure distribution within goshawk habitat areas (FP pp. 27-31), old growth, (FP, pp. 32-34, as well as descriptions, standards and guidelines for Geographic Area 13 (FP, pp. 35-48). Consideration of Public Scoping comments and issues was given in the development of the alternatives, and these comments or issues are addressed in the public scoping comment and summary (PR-26), and/or within the *Consideration of Comments* to the Preliminary EA (see Appendix D-1 & D-2). Also see section 2.4 – *Alternatives Considered but Eliminated from Detailed Study*, below regarding further discussion of issues.]

1.10 Changes to the EA based on Consideration of Public Comments

Between the Preliminary EA and this Final EA for JR, the EA was updated in response to comments received during the 30-day comment period (see Section 1.8 Public Involvement). Changes to the EA based on more recent available information, and public comments and consideration thereof, included the following:

- Additional information was added to address apparent inconsistencies within the EA text itself and with other relevant laws, regulations and policies.
- There were also minor edits and clarifications made throughout the EA and Appendices.
- Appendices C-1 & C-2 were added to summarize the Mitigation Measures, Design features, and best management Practices
- Appendices D-1 & D-2 were included to show the Response or Consideration of Comments to the Preliminary EA (including the Public Comments from the 30-day public comment period on the Preliminary EA)
- Chapter 4 – Tribal Consultation summary was included
- Chapter 5 – References and all tables, maps, and figures have been verified and/or updated and/or finalized.
- Resource specialist reports were finalized and referenced in the EA where necessary.

None of the changes had a major effect on the comparative evaluation of the alternatives or on the conclusions that can be drawn from the EA.

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CHAPTER 2 – ALTERNATIVES

This chapter of the Environmental Analysis (EA) describes and compares the alternatives considered for the Jacob-Ryan Vegetation Management (JR) project. This chapter includes a description of each of the three (3) alternatives considered in detail and those eliminated from study. For comparison of alternatives, this EA presents the **"*Modified Proposed Action*" as Alternative 1**, the **baseline or "*No-Action*" as Alternative 2**, and ***another alternative which imposes a 16-inch diameter cutting limit*** (**Alternative 3**) on the Ponderosa pine type within the forest. The Proposed Action is described in detail in Chapter 1.

2.1 Alternative 1 – Modified Proposed Action (studied in detail)

The Proposed Action has been modified in two ways relative to its description in the scoping letter (Forest Service - June 2, 2002). First, an important soils related issue identified during public scoping (see sections 1.8 and 1.9 above) led to one modification to designate leave units of trees (i.e., units being left untreated – excluded from commercial thinning, heavy equipment, and prescribed fire) and show them on Sale Area Maps to delineate Ecological Map Unit (EMU) 9 areas, which would be excluded from commercial thinning and heavy equipment operations under the Modified Proposed Action. In order to avert potential impacts to the existing poor soil conditions within EMU 9, the proposed action was modified to include simple mitigation measures for EMU 9 area. Thus, the proposed action was slightly modified to state that existing open roads needed for hauling within EMU 9 could continue to be used. However, new disturbances (i.e., skid-trails, landings and other roads) necessary for commercial thinning would not be located within the leave units within EMU 9 area. The Modified Proposed Action in EMU 9 still includes pre-commercial thinning, lopping and scattering slash without follow-up burning, and hand piling and burning of thinning slash only in specific locations where fuel loads exceed 10 tons per acre.

Upon completion of addressing the external scoping comments and development of the Modified Proposed Action, further detailed analysis and modeling led the Interdisciplinary Team to make a second "minor" modification, which was to take a more conservative approach regarding management of the ponderosa pine forest and Goshawk Habitat areas. The second modification to the Proposed Action entails reducing the intensity of treatments in the Foraging Areas (FAs) and Post-fledgling Area (PFAs) to ensure density and canopy cover is adequate for goshawk and prey species. This second modification results in higher and wider ranges of SDI and BA values more appropriate to the unique conditions on the NKRD (productive soils and large ponderosa pine trees). The revised SDIs and BAs are well within parameters for good forest health, with low to moderate stand densities that correlate with desired benchmarks for site occupancy.

The Modified Proposed Action thus includes incremental design features developed through the analysis process to address an *Important* issue and reflect the results of preliminary effects analysis, as allowed by 36 CFR 220.7(b)(2)(iii).

2.2 Alternative 2 - No Action (baseline information – detail used for comparison)

There would be no mechanical vegetation treatments or prescribed burning treatments under the No Action alternative. No restoration efforts would take place and fuels hazard reduction would not occur. Progress toward the desired basal area per acre or stand density indexes would not occur. This alternative would not meet the purpose and need of the project, or the intent of the Forest Plan of management towards an uneven-aged stratum, but it does comply with the National Environmental Policy Act as a basis for comparison with other action alternatives.

2.3 Alternatives 3 ; 16-inch Diameter Cutting Limit (studied in detail)

Alternative 3 was developed in response to issues and concerns expressed by some scoping participants that the proposed action does not protect large trees, and more specifically trees that were established prior to European settlement about 100 years ago (cite). These pre-European settlement trees are larger, older, mature trees. This alternative imposes a 16" DBH cutting limit because that diameter generally represents a 100 year old tree. A previous iteration of this project analyzed both an 18-inch and 12-inch cutting limit on the proposed action or activity. However, neither of those alternatives would have met the purpose and need for this project or Forest Plan desired conditions, and so would have required a Forest Plan amendment. The preliminary effects analysis of imposing a 16-inch diameter cutting limit within the ponderosa pine type forest indicates that implementing this alternative would also fail to meet the purpose and need for this project, as well as Forest Plan desired conditions and therefore it would require a Forest Plan amendment. However, the Responsible Official decided to analyze the 16-inch diameter cutting limit in this EA to clearly disclose to the public the site-specific effects for this project, if such a cutting restriction were to be carried forward.

Alternative 3 would incorporate all of the same mitigations and best management practices as required under Alternative 1 (the Modified Proposed Action), except that tree cutting would be limited to stems less than 16 inches in diameter. The only regeneration openings or areas that would be created would be those that can be achieved within the constraints of a 16-inch diameter limit. Standards for prescribed burning would be the same as in the Modified Proposed Action. Likewise, mitigation measures for the one important issue regarding Ecological Map Unit 9 would be the same in this alternative, as those which are described above for the Modified Proposed Action.

2.4 Alternatives Considered but Eliminated from Detailed Study

A detailed discussion of why these alternatives were eliminated from detailed study is documented in *The Jacob-Ryan Public Scoping Comment Summary* (PR-26) in the project record. This summary report is hereby incorporated by reference and available on request from the District. The following is a listing of those alternatives considered, but eliminated from further detailed study:

a. Most of the active treatment should be in the even-aged stands (Siders): Treating only even-aged stands would leave a large majority of the ponderosa pine type in the project area untreated, thereby failing to meet P&N, for example, in moving VSS distribution toward 10-10-20-20-20-20, to maintain and improve forest sustainability. Whether to restrict proposed treatments to even-aged stands is a matter that was indirectly considered in the development of the Forest Plan, and ultimately the final Forest Plan decision was not to restrict projects so that they could only treat even-aged stands or even-aged strata.
b. Leaving larger openings between tree groups and eliminating reserve trees within openings (AZ GFD): Because size of openings and requirements for reserve trees in openings are matters that were specifically addressed and decided upon in the Forest Plan (FP pp 30 & 43), the Responsible Official decided not to revisit this question in this analysis, and this alternative is therefore eliminated from detailed study.
c. Limiting the creation of forest openings to no more than 2 acres (CBD): Because size of openings was specifically addressed and decided upon in the Forest Plan (FP pp. 30 & 43), the Responsible Official decided not to revisit that question in this analysis, and this alternative is therefore eliminated from detailed study.
d. Conserve all trees greater than 12 inches DBH in even-aged stands (CBD): This alternative duplicates the Proposed Action in even-aged stands where no trees greater than 12 inches would be cut anyway, except for seed trees infected with dwarf-mistletoe, which infect understory trees for as long as the seed trees remain in place. It is possible that this comment reflected misunderstanding about that. But if this comment was serious in suggesting that Seed Trees infected with dwarf-

mistletoe not be cut, then this alternative should be eliminated from detailed study as diameter cutting limits is a matter already considered and decided upon in the Forest Plan (pg. 43). Removal of trees infected with dwarf-mistletoe is listed as a high priority in the Forest Plan when establishing replacement nest stands for northern goshawk. Additionally, reserve trees in regeneration areas are to be mistletoe free per the Forest Plan (FP, p. 43). Therefore, this alternative was not considered practical for maintaining a healthy forest condition in accordance with the Forest Plan goshawk habitat standards and guidelines within the ponderosa pine forest in GA 13.

e. Retain old forest structure, including trees older than 130 years of any size, as well as trees with orange or yellow plated bark and/or flat tops of any size (CBD): Whether to specify management of forest and forest structure based specifically on the age of trees within groups is a matter that has already been considered and decided upon in the Forest Plan (FP, pp. 32-34), and a matter that the Responsible Official does not choose to reconsider or revisit at the project level in the planning and analysis of JR. Per the Forest Plan, old growth allocation is to consist of landscape percentages meeting old growth conditions and not specific acres. The Forest Plan goes on to state that we are to develop or retain old growth function on at least 20 percent of the naturally forested area by forest type in any landscape (Forest Plan, p.32).

2.5 Mitigation Measures & Best Management Practices (BMP's)

BMP's were developed early on during the planning stages of the project and were listed in a white paper or report titled "*Best Management Practices for the Jacob-Ryan Project"* (Project Record PR-27). Both of the action Alternatives (Alternative 1 the Modified Proposed Action and Alternative 3 the 16-inch Diameter Cap) will follow Mitigation Measures. Specific Conservation Measures for California condor are specified in Appendix C-1, while *Design Specifications and Best Management Practices* (BMPs) are listed in Appendix C-2 to the EA.

Since potential mitigation issues and/or measures were included in the planning stages of the project, mitigation measures and BMPs were considered when the Proposed Action and its associated activities were developed (see section 1.3.2.1 – *Proposed Treatments or "Actions" Displayed by Strata*, above). An example of this is action 3(g), which requires the lopping and scattering of slash from current thinning treatments or thin sub-merchantable material, without follow-up burning, to increase levels of coarse woody debris where they are currently deficient. This requirement will lessen impacts to any potential cultural sites or impaired soils in those areas, while directing the downed and course woody debris component towards the desired level of the Forest Plan. Both action Alternatives would require certain mitigation measures during implementation, including BMPs commonly applied to activities to reduce or prevent undesirable resource impacts (such as soil erosion). BMPs come from a number of sources including the Kaibab Forest Plan, Forest Service Handbooks and Manuals, other government agencies and interagency agreements.

2.6 Monitoring

The following monitoring activities would be conducted for any of the action alternatives to ensure BMPs are implemented and to mitigate or avert any potential effects, as they relate to specific resource areas:

- Survey for and treat invasive weed species before, during and after project implementation
- Monitor during and after project implementation for compliance with project specifications, particularly erosion control measures associated with burning and harvesting operations
- Monitor unintended mortality caused during mechanical treatment so that burning prescriptions may be adjusted to maintain the desired forest structure
- Monitor effectiveness of erosion control measures for skid trails, log landings or decking areas, road maintenance and burned areas 5 years following project completion

Proposed Treatments or "Actions" Displayed by Strata, in section 1.3.2.1 above (EA, pp. 5-9), were developed with specific management requirements built into the proposed actions. Defer to Appendices C-1 and C-2 for any additional Mitigation Measures or Design Specifications and Best Management Practices (BMPs) by resource area and any additional monitoring requirements.

2.7 Comparison of Alternatives

This section briefly discusses or compares the Alternatives (i.e., Alternative 1 – The Modified Proposed Action, Alternative 2 – the No Action Alternative, and Alternative 3 – The 16-inch diameter cap Alternative) from either a quantifiable approach and/or a qualitative approach. Table 4, below, evaluates or make a comparison based on quantifiable data, while detailed discussion on the qualitative differences between the alternatives is discussed within the text. However, under Chapter 3- *Environmental Consequences* of this EA, more details are presented regarding "qualitative" traits for those resource areas which have no apparent or a small change regarding a "quantifiable" comparison between alternatives. When making a qualitative comparison, some resources areas must rely upon the best available scientific information or professional experience as it relates to known (past and present) field conditions or data, and modeling of the data to predict future conditions. Modeling can lead to a quantifiable result, but the interpretation of the modeling by resource specialists is more of a qualitative function. For instance, some models cannot account for uncertainties or risk from certain variables, such as disease, drought, and other stressors. Thus, the resource specialist's knowledge and professional experience is relied upon in making predictions of future effects.

Presented below is a comparison of Alternatives regarding Forest Health, Harvest Volumes and Associated Economic Conditions, Risk Assessment for Fire and Fuels Reduction, Northern Goshawk Habitat, and Old Growth.

2.7.1 FOREST HEALTH

"Forest Health" is defined as a forest that is ecologically sustainable, resilient in response to disturbances such as insects, disease, drought and fire and able to maintain its species and habitat (EA, *Acronyms / Terms and Definitions*, p. *xii*). Improving forest health objectives within the Jacob Ryan project area is primarily achieved through meeting northern goshawk habitat conditions within the ponderosa pine type forest as identified in the Forest Plan. For more information regarding Forest Health, see Section 3.2.1 – Vegetation Resources, below.

The only factors included in this comparison are those where there is a quantifiable difference between the alternatives. All other factors and resources (e.g. Watershed and Soils, Wildlife, Range, Heritage, Recreation and Scenery) use a qualitative discussion or approach to show either similarities or differences between the action alternatives, which are described in Chapter 3 in more detail. Table 4 compares the alternatives analyzed in detail to each other and to the desired conditions as specified in the Forest Plan. More detailed discussion of the differences between alternatives can be found in the Vegetation Management, and the Fire and Fuels specialists' reports, as summarized in Chapter 3, below.

Table 4. Comparison of Alternatives after treatment showing differing Forest Health values in the Uneven-Aged Stratum.

Project Activity and Effects	Desired Condition	Alternative 1 Modified Proposed Action	Alternative 2 No Action	Alternative 3 16-inch Cutting Limit
Vegetation management treatment results - Foraging Area (FA) [after 5 years and after (20 years) without re-entry]				
Basal Area (ft.²/ac)	55-80	76 (106)	128 (152)	101 (122)
Stand Density Index (SDI)	112-180	172 (221)	289 (322)	206 (240)
Mortality (ft.³/ac./yr.)	Less than 7	3 (7)	7 (11)	4 (8)
Vegetation management treatment results - Post Fledging Area (PFA) [after 5 years and after (20 years) without re-entry]				
Basal Area (ft.²/ac)	70-90	87 (113)	131 (154)	106 (128)
Stand Density Index (SDI)	135-190	189 (229)	300 (333)	219 (250)
Mortality (ft.³/ac./yr.)	Less than 7	3 (7)	7(11)	4(8)
Percent of Acreage by VSS Class Distribution in Uneven-aged Stratum [after 5 years and after (20 years)]				
VSS 1 (0 – 0.9 inches)	10	9 (9)	5 (5)	6 (5)
VSS 2 (1 – 4.9 inches)	10	13 (4)	10 (5)	7 (1)
VSS 3 (5 – 11.9 inches)	20	18 (21)	18 (18)	16 (17)
VSS 4 (12 – 17.9 inches)	20	20 (20)	23 (22)	22 (22)
VSS 5 (18 – 24 inches)	20	20 (20)	23 (24)	26 (26)
VSS 6 (24 inches +)	20	20 (26)	21 (26)	23 (29)
Acres of Regeneration Openings Affecting Active and Passive Crown Fire[11]				
Acres of Canopy Gaps based on regeneration	N/A	724	0	145

As shown in table 4 above, within the FA's and PFA's, basal area is tied closely with SDI levels in the uneven-aged stratum. When considering the effectiveness of reducing basal area (BA) between the two action alternatives, Alternative 1 results in a post-treatment basal area of 76 ft^2/ac, which falls within the desired range of 55-80 ft^2/ac for Goshawk FA's, while Alternative 3's post-treatment is outside the desired range at 101 ft^2/ac BA. A similar result occurs in Goshawk PFA's where the desired range is 70-90 ft^2/ac BA. Alternative 1 after treatment is at 87 ft^2/ac BA, while Alternative 3 is at 106 ft^2/ac.

Within the Goshawk Foraging Area (FA's) the desired conditions for SDI ranges from 112 to 180, while within the Goshawk Post-fledgling family areas (PFA's) 135-190 SDI is desired. When considering the effectiveness of reducing stand density or SDI levels between the two action alternatives, Alternative 1 results in a post-treatment SDI of 172 within the FA's and 189 within the PFA's. Alternative 3 SDI levels

[11] Regeneration openings create canopy gaps that affect the passive and active crown fire activity. In uneven-aged conditions canopy gaps are important as structural elements that allow a running fire to fall to the ground, and improve suppression success and potentially prevent stand replacing fires.

are 206 within the FA's and 219 within the PFA's, which are outside the desired ranges. The No-Action Alternative has the least desirable SDI levels at 289 and 300 for FA's and PFA's, respectively.

Of the alternatives considered, the Modified Proposed Action comes closest to achieving desired conditions for basal area, stand density index (SDI), and mortality. The No Action Alternative deviates the most from desired Forest Health conditions, while Alternative 3's results are intermediate between No Action and Modified Proposed Action. While the Modified Proposed Action succeeds in lowering SDI to (or below) the desired level, SDI under Alternative 3 never reaches or achieves the desired level, even right after treatment. Under Alternative 3, tree stocking would steadily increase to self-thinning levels, which would mean that multiple entries of treatment would be necessary in the future. However, under Alternative 1 (the Modified Proposed Action) the SDI level always stays below and never reaches the self-thinning level throughout the modeling period (which is preferred from a forest health and management standpoint).

One major differences between the Alternative 1 (Modified Proposed Action) and Alternative 3 that is very apparent in the field and the data (especially in the short term), is the regeneration of **724 acres** of VSS 4 – 6 into VSS 1. These acres regenerated create openings which promote balance of size classes 4 – 6, and moves VSS 1 from 5 to 9 percent.

Experience from similar projects on the North Kaibab District and first-hand knowledge of conditions in the field is also very important when evaluating the alternatives and making comparisons of various proposed actions. A recent project, called Fracas, is a good example of implementation of a project with a 16-inch diameter cap in the uneven-aged strata of the ponderosa pine type forest. Yet even after completion of this project, it created no openings, had a lack of regeneration under the dense overstory, and still has a very high residual basal area. The consequences of very high residual basal areas after treatment, means that the stands are still susceptible to disease like the bark beetle and dwarf mistletoe. Additionally, when you compare the 16-inch diameter cap alternative (Alternative 3) to the Modified Proposed Action (Alternative 1), Alternative 3 would only regenerate **145 acres** of regeneration openings or canopy gaps, and would eventually result in an even-aged stand condition, which is contrary to the desired conditions of the Forest Plan.

Modeling with the Forest Vegetation Simulator (FVS)[12] provides quantitative information, especially for current stand conditions, yet it is limited in its predictions the longer the time span. As an example, periodic drought occurs on the NKRD, but it cannot be accounted for in the FVS modeling. Given that the frequency of fire within the ponderosa pine type on the NKRD is every 3 to 5 years, it is not realistic to project 20 or 40 years into the future without any qualification that disturbance is very likely to occur in the form of fire, insects, disease, wind, or other natural catastrophe. There have not been any recent prescribed fire treatments within the project area for the past 10-12 years, because previous proposals for treatment in this area have been challenged and/or cancelled due to appeals or because they did not meet the intent of the Forest Plan. All wildfires within the project area have been suppressed because this project has been in the development phase for so long.

The main differences between the action alternatives (Alternative 1 and 3) are in their effects on future Forest Health and the desired VSS structuring across the landscape. Over time, use of diameter cutting limits sacrifices VSS 1 recruitment and moves the forest back towards an even-aged structure of overly dense large trees. This regression means that you are maintaining an excessive Stand Density Index or

[12] The Forest Vegetation Simulator (FVS) is a family of forest growth simulation models. The basic FVS model structure has been calibrated to unique geographic areas to produce individual FVS variants. Since its initial development in 1973, it has become a system of highly integrated analytical tools. These tools are based upon a body of scientific knowledge developed from decades of natural resources research.

numbers of trees per acre, which is contrary to good Forest Health and also contrary to Forest Plan desired conditions. Alternative 3, with its stricter diameter limit and higher stand densities, does not regenerate enough VSS 1 and puts VSS 4 – 6 at a higher percentage that the No Action alternative. Out of all the alternatives, Alternative 1 would maintain the best uneven-aged structure while creating regeneration openings for VSS 1.

Dwarf Mistletoe: It is estimated that approximately 950 acres of dwarf mistletoe exists within, and spread across the JR project area. Alternative 1 would allow for removal or isolation of dwarf mistletoe infected trees. Alternative 3 would allow for removal of infected trees less than 16-inches DBH. Dwarf mistletoe infection occurs both within the even-aged and uneven-aged stratums of the ponderosa pine type forest. Per the Forest Plan (FP, p. 43) and the proposed actions [See EA, Section 1.3.2.1, Proposed Actions 1(c), 3(c), & 5(e), pp. 7-8], Alternative 1 treatments were developed to consider the isolation of infected trees as potential wildlife habitat (where practicable). Under Alternative 1, there will be certain stand conditions such that removal of a few trees greater than 16-inches DBH is preferred, in order to protect regeneration areas from possible future infection. Additionally, there may be instances where a group of mistletoe infected trees would be removed to create a regeneration opening (usually an acre in size or less). Under these conditions, both removal of mistletoe infected trees and creating regeneration openings would be the treatment objectives. Under the "No Action" Alternative and Alternative 3, there would be continued infestation and spread of dwarf mistletoe infection (at a rate greater than that which would occur under Alternative 1). (EA, pp. 37, & 39-40).

[Note: Comments were also received during the 30-day public comment period to the Preliminary EA, which potentially involve dwarf mistletoe; see responses or *Consideration of Comments* (Appendix D-1), L3-C5 (Bullet no. 4), L5-C4, L5-C14 & 15, and L6-C2.]

2.7.2 HARVEST VOLUMES AND ASSOCIATED ECONOMIC CONSIDERATIONS

The differences are significant between Modified Proposed Action (Alternative 1) and Alternative 3 (Action with a 16-inch diameter cap). Alternative 1 has more harvest volume potential than under Alternative 3 because trees 16 inches in diameter and larger are excluded from mechanical thinning under Alternative 3. Therefore, with more volume harvested per acre under Alternative 1, the Modified Proposed Action's estimated value would be greater. Greater revenues would help fund service-cost items such as pre-commercial thinning and prescribed burning, which are very important issues to consider in times of economic downturn or stagnate growth, when government operations are being managed with smaller limited budgets.

Again, using "Fracas" as an example of a recent project on the North Kaibab District for comparison, thinning costs in the even-aged stands within the ponderosa pine type could approach $2.0 million within the JR project area. In key habitat nest stands, a combination of thinning and piling could cost over $1.4 million. Prescribed burning in even-aged FAs could be about $1 million. These examples do not cover the entire project area as there would be more pre-commercial thinning in uneven-aged stands, and more burning as well. These estimates alone put the cost at over $4.4 million. The Modified Proposed Action (Alternative 1) would help offset these costs better than Alternative 3.

The Modified Proposed Action (Alternative 1) would be desirable to potential timber purchasers because the volume per acre harvested would have more economical value than Alternative 3. Due to his recent experience with the Fracas sale (i.e., a sale with an imposed 16-inch diameter cutting limit) and very high logging costs per unit of production, one logger commented that he would not be able to make any profit if he were to have to purchase a sale with a 16-inch diameter cap (Paul Callaway, NKRD TMA, 2010). See Vegetation Resource Specialist Report (2011, PR-34) for a comparison of volume harvested and estimated stumpage for the Proposed Action (Alternative 1) versus Alternative 3.

2.7.3 RISK ASSESSMENT FOR FIRE AND FUELS REDUCTION

Based on modeling that was performed, when you compare the desired condition to either action alternative, both action alternatives provide almost equal amounts of fire and fuels reduction and the capability to manage wildfires on the ground. While differences in levels of crown bulk density would logically be important in making a comparison between the action alternatives, there is only a slight difference in crown bulk density due to the fewer number of trees being harvested under Alternative 3. What stands out quantitatively, is the difference between the No Action Alternative and either action alternative, is the potential for uncharacteristic, high severity wildfires (active and passive crown fire potential) to occur in the future throughout the project area (Refer to Table 4 of this EA and Appendix B, Figures B-1 through B-3).

Modeling does have limitations. For example, some models such as FlamMap, displays fire behavior characteristics, but it does not capture the accelerating active crown fire activity that would occur in more continuous canopy cover conditions on a windy day with spotting ahead of the fire from blown embers. Additionally, modeling does not or cannot account for additional variables, such as future events like potential drought, insect epidemic, or wildfire. An example is the areas located outside the proposed JR treatment area, which are areas that are densely forested (e.g., considered to have a high fuel load) in the understory. These areas pose a risk to the JR project area regarding their potential for an active or passive crown fires originating from these outside areas.

The Modified Proposed Action Alternative would increase surface fine fuels in the form of understory vegetation (i.e., primarily in the form of grasses). Much of the species diversity in ponderosa pine forests is contained in understory vegetation (Moore et al. 1999). Understory vegetation can be 10 times higher in restored openings than under even sparse ponderosa pine cover (Clary 1975). This vegetation is key in supporting fire spread similar to that under which southwestern forests have evolved. This increased continuity and availability of fine fuels, coupled with a more open canopy actually results in increased rates of spread. However, since the canopy base height is raised, and canopy bulk density is decreased, initiation of torching and crown fires is decreased. Achievement of these desired conditions for surface and canopy fuels would allow fire to function as a natural disturbance within the JR ecosystem without causing loss to ecosystem function or to human safety, lives and values.

Based on both SDI and BA post-treatment levels as discussed under section 2.7.1 – Forest Health above, Alternative 1 is more effective in lowering stand density than Alternative 3 and the "No Action" Alternative. This reduced stand density results in less competition for resources (i.e., water and nutrients) among remaining trees, increased resilience to drought, stress, insect attack and disease, increased understory plant diversity, and reduced risk to crown fire.

2.7.4 NORTHERN GOSHAWK HABITAT

The analysis of the distribution of habitat structures (tree size and age classes, tree groups of different densities, snags, dead and down woody material, etc.) should be evaluated at the ecosystem management area level (large scale), at the mid-scale level (such as drainage), and at the small scale or site level. The Forest Plan (Forest Plan, page 29) requires that the effects for vegetative structure are assessed at three scales. The analysis for the JR project was conducted at the group level, stratum level and at the larger ad-hoc analysis area (See section 3.1, "*Scales of Analysis*" below). Goshawk habitat stratums analyzed include: uneven-aged FA, PFAs and nest areas and even-aged FAs and PFAs (See Figures 3 and 4 above). As part of the vegetation management analysis, existing and post-treatment conditions were evaluated at all these scales.

When comparing alternatives, the No Action (Alternative 2) would not change existing conditions of high stand density, stunted growth rates, and competition-induced mortality amongst the trees within the ponderosa pine type forest. No change would occur in existing trends toward increased ladder fuels, fuel loading, and vulnerability to wildfire, insects and disease. No Action does not meet northern goshawk habitat objectives, purpose and need for this project, or Forest Plan desired conditions for GA 13.

The Modified Proposed Action creates more suitable goshawk habitat than Alternatives 2 and 3 through cause-and-effect relationships, which results from removing more trees per acre for density reduction. Thus, the reduction in density provides for more nutrient and moisture uptake, and increased vigor of residual trees. The reduction also allows for individual tree removal of dwarf mistletoe infested trees (greater than 16-inches DBH), provides for more regeneration openings to improve age class distribution, while working towards desired VSS class percentage distribution and structure, and maintaining canopy cover. The Modified Proposed Action will result in VSS percent distribution closely approximating the desired VSS percent distribution called for in the Forest Plan. The additional cause-and-effect relationship that is relevant here, proceeds from removing more trees per acre, that in turn: (1) reduces ladder fuels and creates more regeneration openings; (2) provides breaks in an otherwise continuous forest canopy reducing risk from uncharacteristic crown fire that could destroy goshawk habitat, and; (3) allows for fire suppression efforts to be more successful and safer.

Under Alternative 3, the cutting diameter limits the ability to thin stands effectively, thus affecting both the short term objective for improved stand health and the long term effectiveness of treatments. Density reduction objectives are not met even immediately after cut and within 20 years are back to similar levels as Alternative 2. The ability to remove dwarf mistletoe infected trees threatening healthy advanced regeneration in the even-aged strata is restricted. The diameter limit also affects the ability to move groups and clumps throughout the range of size classes, and eventually promotes a more even-aged structure that creates a homogeneous unit lacking diversity and desired habitat characteristics. In the Uneven-aged Strata, the VSS 5 and VSS 6 vary more than 3% from their desired percentages for goshawk habitat And VSS 1 is not moving toward desired percent distribution, (See page 24, Table 4). Under Alternative 3, after 5 years, VSS 5 and VSS 6 would increase to 26% and 23%, respectively, while the Forest Plan desired condition for both is 20%. VSS 1 has only increased 1% (from 5% to 6%) where the desired condition is 10%.

Both action alternatives would make progress toward desired levels of snags, downed logs and coarse woody material by implementing design criteria.

2.7.5 OLD-GROWTH

The Forest Plan states that management of northern goshawk habitat should be *to manage for old age trees such as much old forest structure as possible is sustained over time across the landscape* (Forest Plan, p. 27). The Forest Plan goes on to state that allocation of no less than 20 percent of each forested Ecosystem Management Area (EMA) or landscape to old growth (Forest Plan, pp. 32-34). Additionally, the amount of old growth that can be provided and maintained will be evaluated at the EMA level and be based on forest type, site capability, and disturbance regimes. The Forest Plan states that old growth should be analyzed as multiple scales; for the JR project those scales were the project area, the ad-hoc analysis area, and Geographic Area 13. Standard and guidelines for old growth are met at all 3 required scales of analysis. For a more detailed discussion on the scales of the analysis areas, see the "Vegetation" section of Chapter 3 (See "Old Growth Analysis," p. 44). The requirement for old growth allocation, per the Forest Plan, would be maintained or achieved under both action alternatives and the no action alternative. Both action alternatives (Alternatives 1 and 3) would retain or promote groups of VSS 5 and 6 in their proposed

treatments, and move the ponderosa pine community toward the desired conditions in the Forest Plan. However, when looking at VSS 5 and 6 groups and class distribution over time, Alternative 3 moves further away from desired conditions (i.e., 20% +/- 3% for VSS 5 and VSS 6 groups regarding class distribution).

Within the JR project area, approximately 80% of all old growth allocation occurs within the northern goshawk nest stand areas. Under both Alternatives 1 and 3, Nest Areas will be thinned from below up to 12-inches DBH (EA, pp. 7, Actions in Nest Area Habitat Strata). This would protect the larger trees to some degree by removing competition and fuel ladders. However, the "No Action" areas would remain at a higher level of risk due to no thinning of ladder fuels under the canopy areas. Thus, old growth within nest stands will be protected to some extent under both action alternatives. Additionally, there are 848 acres of non-treatment areas (i.e., slopes over 40%) which also contain some allocation of old growth.

Under Alternative 1, some selective harvest will occur within VSS 5 and 6 groups. Some of these groups may or may not be classified or allocated as old growth based on the Forest Plan definition. However, overall percentage of old growth areas within the project area would remain at approximately 21% post-treatment. Due to regeneration of VSS 5 and 6, a reduction of old growth of up to 0.4 % may occur under Alternative 1. However, it would be possible to minimize this reduction through the application of silvicultural prescriptions using selective thinning, or group selective thinning, to keep enough old, large trees, and basal area and canopy cover to retain those VSS 5 and 6 groups with old growth characteristics, where applicable.

The traditional view of old growth (as a continuous closed canopied forest of large old trees, typical of that which occurs in the pacific northwest), simply is not sustainable in the Southwest where most forests evolved with frequent fires. Old growth standards and guidelines in the Forest Plan (FP, pp. 32-34) seek to maintain a "flow" of large old trees across the landscape both spatially and temporally. The management or allocation of old growth within the ponderosa pine type forest should seek to mimic (but do not replicate) forest conditions that occurred prior to European settlement, where large old trees occurred in clumps/groups across a landscape of open forest. The Forest Plan standards require a minimum of 20% of each forested EMA be allocated to old growth. Old growth Habitat Characteristics (per table 15 of the Forest Plan, FP p. 34) also includes the following: (1) maintain at least 20 trees per acre making up the canopy, with a plurality of basal area in tree groups between 14 – 18 inches DBH (for low and high site index) and approximately 180 years old. (2) One standing dead tree at least 14-inches in diameter, with a minimum height of between 15-25 feet tall, (3) two downed pieces of woody debris per acre at least 12-inches in diameter and 15 feet in length, and (4) total basal area of at least 70-90 square feet per acre, with at least 40% total canopy cover.

The Modified Proposed Action would implement the Forest Plan with no diameter limit. Underlying all management objectives in the project area is the major goal of restoring more fire-adapted conditions in the ponderosa pine forest that are also more resilient to other disturbance episodes like insect attack and disease.

Although there are some species which are obligated or much dependent upon old growth and its function (i.e., old growth obligates) we do not have any old growth obligates in the JR project area. For example, even old-growth obligate species (such as the northern spotted owl) do not need old growth, they need the structure and ecological condition that the old growth provides, which can actually be found in 2nd and 3rd generation forests. Wildlife has no preference based on the age of the tree, as long as it has the structure and ecological condition for its 3 basic needs (and the 3 basic needs of its prey species if it is a predator): food, water and shelter.

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CHAPTER 3 - ENVIRONMENTAL CONSEQUENCES

This chapter provides information concerning potential effects and consequences in implementing the Jacob-Ryan Vegetation Management (JR) Project. It also presents the scientific and analytical basis for comparison of alternatives as presented in Chapter 2. Direct, indirect and cumulative effects are disclosed, quantified where possible, and interpreted as to qualitative changes in resource conditions. This chapter also describes the means by which potential adverse effects would be reduced or mitigated (see also Chapter 2 and "*Best Management Practices for Forest Vegetation Management"* (PR-27).

Discussions of resources and potential effects take advantage of existing information included in the Forest Plan's FEIS, project-specific resource reports and related information, and other sources as indicated. Where applicable, such information is briefly summarized and referenced to minimize duplication. The planning record for the JR Project includes all project-specific information, including resource reports, other results of field investigations, and information resulting from public involvement efforts. The planning record is located at the North Kaibab Ranger District office in Fredonia, Arizona and can be reviewed during regular business hours. Information from the record is available pursuant to the Freedom of Information Act.

This chapter uses the best available science to provide the analytical basis for the comparison of alternatives. It also uses the three scales of analysis for northern goshawk habitat per the Forest Plan. Boundaries for cumulative effects analysis are not necessarily the same boundaries for effects analysis for northern goshawk habitat. Boundaries for cumulative effects analysis may vary by resource, as described and explained in each major section.

3.1 Scales of Analysis

The Forest Plan divides the forest into geographic areas (GA) which contain specific desired conditions and management direction. The JR project lies within Geographic Area 13 - Kaibab Plateau Forestland (GA 13), which is managed for multiple-use (See Figure 7 – next page). Below is a brief description of GA 13, per the Forest Plan:

Geographic Area 13 - Kaibab Plateau Forestland: 268,719 Acres

"Geographic Area 13 is located in the middle of the North Kaibab Ranger District. It is part of an elevated plain dissected by numerous drainage systems. Elevations range from 7,000 feet to over 9,000 feet. Drainage systems are well-defined and flows are ephemeral. Annual precipitation ranges from 18 to 30 inches. Ponderosa pine predominates in most of this management area, except at higher elevations and on cooler sites. Understory species include mutton bluegrass, blue grama, squirreltail, junegrass, *Carex* sp., and mountain muhly. Mixed conifer and spruce-fir vegetation cover a major portion of this area. Aspen is scattered throughout in pure stands and as a component of both the overstory and understory vegetation. In openings and thinned stands important forage producers are pine dropseed, mountain muhly, tall oatgrass, weeping brome, and smooth brome. The forb component includes yarrow, ragweed, columbine, sandwort and cinquefoil. In dense conifer stands, *Carex* sp. and the forb component is essentially the only understory vegetation."

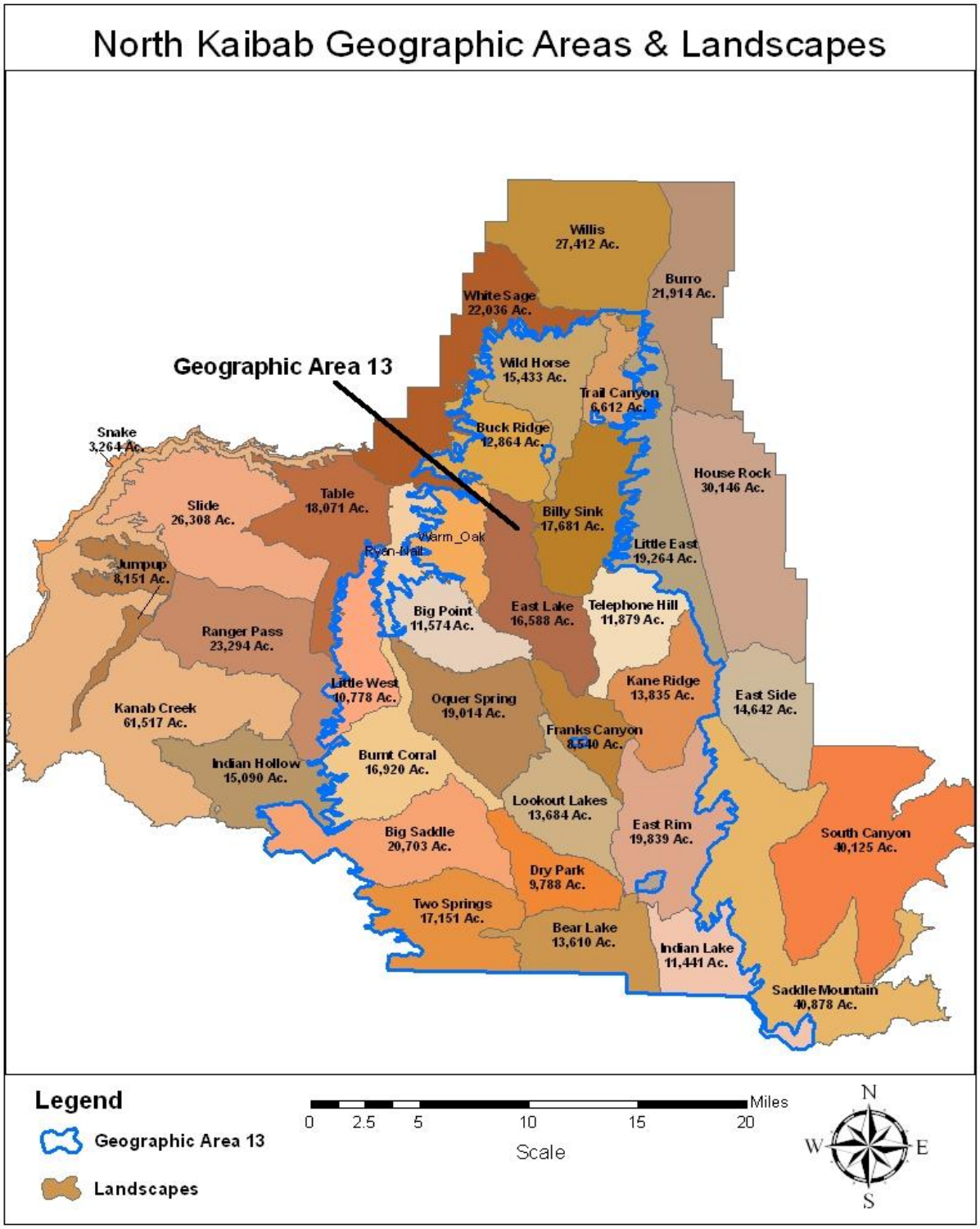

Figure 7. North Kaibab Geographic Area 13 and Ecosystem Management Areas (EMAs) Map

Per the Forest Plan all resource operations and improvements should aim at attaining resource management objectives and contribute to bringing desired conditions into being. All desired conditions focus on conservation of the ecosystem and the human environment. To ensure the focus is on the ecosystem, the Forest Plan establishes ***landscapes*** or ***Ecosystem Management Areas (EMAs),*** which are to be evaluated or used in the analysis process (Forest Plan, pp. 7-8). The Forest Plan emphasizes group selection forest vegetation management that moves the stand structure toward uneven-aged conditions similar to the historic forest. The Jacob-Ryan Vegetation Management project was developed to make progress towards those desired conditions.

The Forest Plan provides a guideline for analysis regarding the effects of vegetative structural stages (VSS) as suitable habitat for northern goshawks and their associated prey species. The habitat assessment includes the landscape VSS percent distribution along with the necessary snags, dead and down woody material per acre. ***Per the Forest Plan, a Management Scale analysis includes "three" different levels of analysis.*** The analysis of the distribution of habitat structures (tree size and age classes, tree groups of different densities, snags, dead and down woody material, etc.) should be evaluated at the ecosystem management area level (large scale), at the mid-scale level (such as drainage), and at the small scale or site level. (Forest Plan, page 29).

The scales of analysis were modified for JR to accommodate the size of this project, the type of vegetation treatments proposed, and the predominance of ponderosa pine within the project area. The small scale of analysis is derived from point data which treats the plot as if it were a site. The mid-scale analysis is the strata level. VSS distribution percentages are only quantified for the uneven-age stratum, because the even-aged stratum includes only one or two VSS classes. At the large scale of analysis, an ad-hoc analysis area is evaluated (**Forest Plan, page 38**) because the project area covers all or portions of six EMAs (**about 78,000 acres**). Combining the six EMAs as an ad-hoc area provides a more ecologically appropriate area for the large scale analysis in relation to the rather large mid-scale analysis area (i.e., the project area ~ **25,297 acres**).

Initially, the large scale or ad-hoc analysis area for JR included all area within each of the *six EMAs or landscapes: Wild Horse, Buck Ridge, Trail Canyon, Warm Oak, East Lake, and Billy Sink,* (See Figure 7). The vast majority of this area is the ponderosa pine forest type with the same fire regime condition class[13] as that which occurs inside the JR project area. However, in developing this EA, it became clear that the southern portions of the East Lake and Billy Sink landscapes, above 8,500 feet in elevation, are in a different ponderosa pine seed zone (for cone collection and reforestation purposes), a different forest type (mixed conifer) with a different fire regime and condition class, and a different type of habitat (for Mexican spotted owl) – different not only from JR, but also from the vast majority of other areas within these six landscapes. These differences are mainly due to elevation and historic patterns of wildfire. *Thus, the ad hoc analysis area for JR extends southward only up to the 8,500 foot elevation contour line.* This is why analysis of goshawk habitat in this EA does not include most of the Warm Fire Suppression or Recovery areas. Only about 7,900 acres of the Warm Fire Suppression area and about 160 acres of proposed treatments under the Warm Fire Recovery project lie below the 8,500 foot elevation within East Lake and Billy Sink landscapes. (See Figure 8).

The three scales of analysis provide the general boundaries for analysis of forest vegetation, fire and fuels and wildlife as they apply to habitats for the northern goshawk and their prey species. Thus defined, the existing structural stage (VSS) data for these analyses is limited to about **69,000 acres** instead of the approximate 78,000 acres referenced above. The 9,000 acre difference equals the area in other vegetation

[13] Fire regime condition class (FRCC) is an index of ecological departure from reference fire conditions from 1 to 3 with 1 being the least amount of departure. The FRCC departure metric can be derived by evaluating the change in composition of succession classes, fire frequency, and fire severity (Hann and others 2004).

types than ponderosa pine (i.e., strata level or type) such as pinyon pine, juniper, aspen and meadows, none of which are being proposed for treatment under JR. In this analysis the ad-hoc boundary for the goshawk habitat analysis is also the Cumulative Effects Analysis (CEA) boundary for Vegetation resources, Fire and Fuels and Wildlife.

CEA boundaries for other various resources should not be confused with the scales for goshawk habitat analysis in Vegetation, Fire and Fuels, and Wildlife. CEA boundaries for other resources (such as soils and watershed) may or may not coincide with the scales for goshawk habitat analysis in Vegetation, Fire and Fuels, and Wildlife. Cumulative Actions depicting past, present and foreseeable future projects on the North Kaibab Ranger District are evaluated by individual resources below. Each resource provides details on specific CEA boundaries and associated rationale for their combined effects along with the JR Project on the CEA area.

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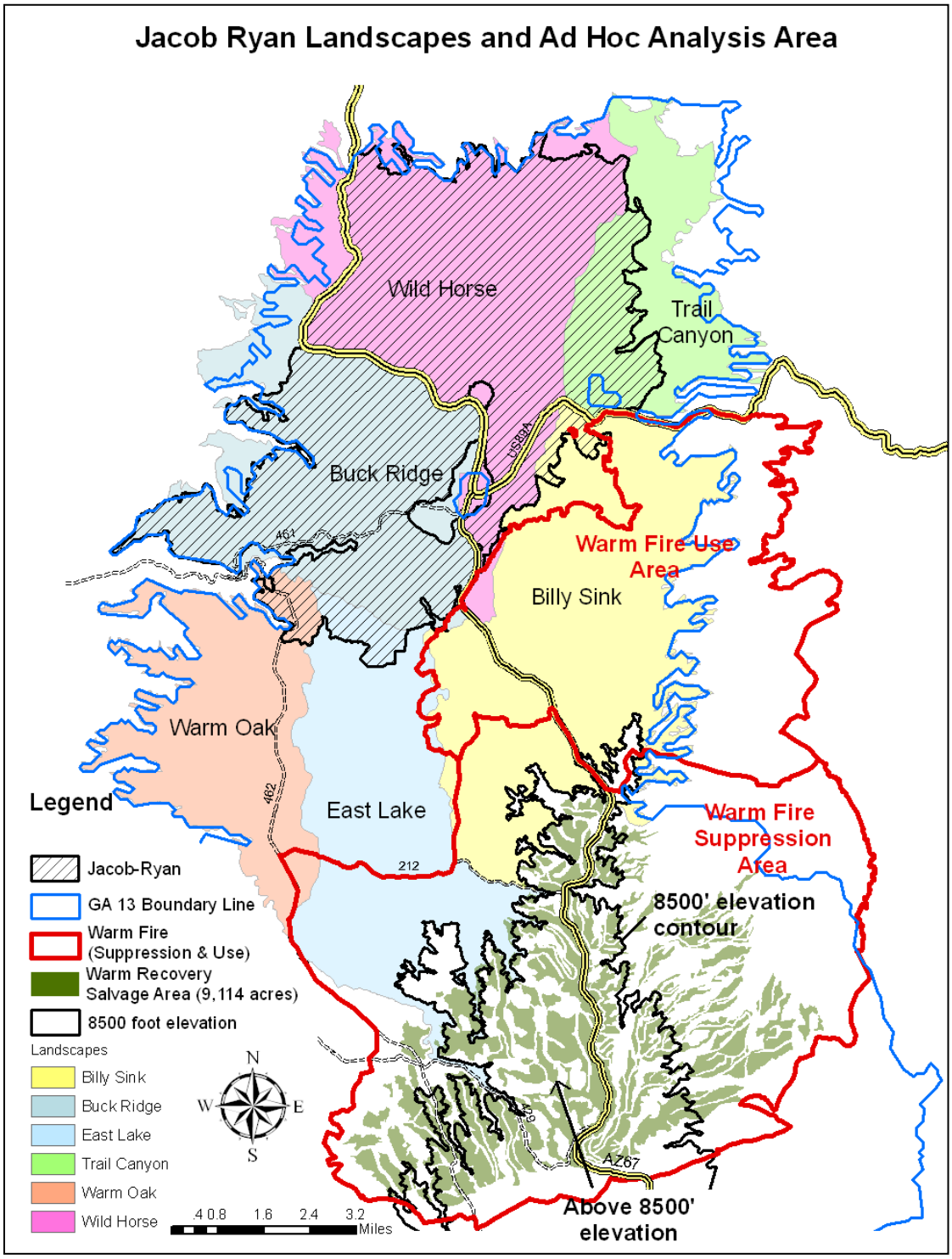

Figure 8. **Jacob-Ryan Landscapes and Ad-hoc Analysis Area** [i.e., Six (6) EMAs or Landscapes (*Wild Horse, Buck Ridge, Trail Canyon, Warm Oak, East Lake, and Billy Sink)* within Geographic Area 13 boundary, and below the 8,500 foot elevation contour for seed zone change for ponderosa pine. These parameters are what define the Jacob-Ryan ad-hoc analysis area for goshawk habitat.]

3.2 Environmental Effects by Resource Area

3.2.1 VEGETATION RESOURCES

➢ EVEN-AGED STANDS

Stand-level summary statistics were used to stratify the project area into categories based on the type of stand. The Even-aged stratum covers approximately **6,293 acres**, and due to homogeneity or uniformity in the stands, VSS was determined for the whole-stand or stand level (Common Stand Exam summaries). Since the shelterwood units with residual trees left over after treatment would not be designated for final removal, the VSS classifications were based on the regenerated forest in those areas (see Table 2 above). This basically means that overstory was not used to classify VSS in two-storied stands.

Dominance and basal area, as related to the determination of VSS, is described in the Vegetation Management (Resource) Specialist Report, dated October 27, 2011.

➢ Direct and Indirect Effects

Natural or man-caused disturbance is likely to occur in the JR project area as evidenced by past fire history on the Kaibab Plateau. Proposed thinning treatments in JR would at least create some fire resistance in the form of reduced tree density, and created openings up to 2 acres. However, the Forest Plan (Forest Plan S&Gs, pg. 30) allows for openings of up to 4 acres in size, with a maximum width of up to 200 feet. And one (1) group of reserve trees (3-5 trees per group) will be left in place if the opening is greater than an acre in size. The direct effect of openings is greater fire resistance and restoration of the ponderosa pine forest to historic conditions, which also benefits other resources, such as wildlife, recreation, and various uses of the forest.

1) Alternative 1 - Modified Proposed Action

The Modified Proposed Action would regenerate approximately 15% of the even-aged stands in small groups and clumps. The focus would be cutting trees less than 11.9-inches DBH, and move the area towards uneven-aged condition. Almost the entire acreage of the Even-aged stratum is classified as VSS 1- 3. This condition represents an opportunity for tree removal to move the area toward uneven-aged condition.

For both immature and mature stands, irregular density thinning would be conducted to create some groups, openings, and more diverse vegetation patterns. The Desired Condition in even-aged stands indicates a need for more acreage in VSS 1. So the Modified Proposed Action would increase that acreage primarily by cutting trees between 5.0 to 11.9 inches in diameter at breast height (DBH). There would also be opportunities to thin excess trees from 1.0 to 4.9 inches in diameter, especially in dog-hair thickets, to improve growing conditions and forage production.

The Desired Condition is a VSS distribution of 10-10-20-20-20-20 percent of area in VSS 1 -6 distributed evenly across the area of current even-aged stands (almost entirely VSS 1 – 3). In one-storied even-aged stands, two treatments would be required to achieve uneven-aged condition. In those two-storied stands that resulted from previous seed tree and shelterwood treatments, one treatment or entry would move the area into uneven-aged condition as openings and VSS 1 are created. With seed trees scattered through our shelterwood units, we can remove excess regenerated trees and make openings to allow natural

regeneration to occur. Eventually, with good seed years and moisture, we would increase acres of VSS 1 naturally. The following photograph (Figure 9) displays large seed trees surrounded by regenerated saplings.

Figure 9. Example of a shelterwood treatment unit in JR project area with scattered seed trees above an established understory.

Due to past even-aged treatments desired conditions for canopy cover in VSS 4 – 6 do not currently exist in the even-aged stands. The proposed treatments under Alternative 1 will initiate long term progress toward the desired structural and canopy closure conditions.

For this project, the NKRD would implement the Kaibab NF Forest Plan for the northern goshawk habitat standards and guidelines. There would be no diameter limit to cutting, and we would have the flexibility to remove diseased or infested trees in the even-aged stands. Most of the thinning would be pre-commercial trees up to 9 inches DBH, with the option to take commercial trees if diseased or infested. This would be the case in areas where the seed trees are infected with dwarf-mistletoe, and the surrounding young trees are healthy and free of disease. By removing the source of infection, the direct effect would be disease free regeneration. In certain instances it would be possible to isolate larger mature trees infected with dwarf-mistletoe, these trees would be retained using selective or group selective cutting. The retention of these larger mature infected trees may help improve habitat for wildlife; see section 3.2.4 of this EA for analysis of wildlife.

The direct effects are benefits derived from reducing excess tree density, and improving growing conditions with more light, moisture, and nutrients. In the even-aged stratum, both action alternatives would result in regeneration of 15% of 6,293 acres of even-aged stratum, thus creating 944 acres of regeneration openings (generally ranging in size from a ¼ acre to 2 acres in size).

Further results of the FVS[14] model run are presented and described in the Vegetation Management Specialist Report for JR (2011, PR-35).

Pre-commercial thinning with the flexibility to remove trees > 9-inches DBH has even greater forest health benefits in even-aged foraging stands. The indirect effects are manifested with improved forest health. The basal area, trees per acre and SDI are within healthy forest parameters, especially SDI. After treatment, SDI is 94 (21% of maximum), 30% (site occupancy) in year 2030, and 40% in year 2050 (about mid-range for site occupancy). All SDI metrics are well below the onset of self-thinning levels, about 57% of maximum. Although the FVS model runs indicate good volume per acre to be harvested, the number of actual trees removed would be greatly reduced using silviculture prescriptions, as healthy seed trees would be retained to meet forest plan requirements.

Prescribed fire would also be used in the JR project. Refer to or see Fuels Section below and SVS [Stand Visualization System in *Fire and Fuel Models for Vegetation Management* (PR-25)] pictures for Stand 1640003 at the beginning of a controlled burn, after fire, and at the end of the simulation period (see Appendix A, Figure A-1 through A-3).

This stand responded well to both thinning from below, and controlled fire under moderate conditions of moisture, temperature, and wind speed. The stand has a small component of aspen that was stimulated by the ground fire, and populated part of the stand with fire resistant trees. Thinning from below created enough openings to allow fire to play a role, and leave overstory trees in a healthy condition. Understory ponderosa pine trees also survived the ground fire, and would provide areas of successful regeneration for future needs.

Concerning goshawk habitat, existing nest stands are critical to the success of fledging and rearing young raptors. Thus, modeling was intentionally performed in this habitat type to understand the effects of thinning and controlled fire in crucial areas.

The even-aged stands in JR compose a large part of the project area. Under the Proposed action, the first entry or treatment is designed to move these stands towards an uneven-aged condition, to improve forest health with thinning and prescribed fire, and maintain a fire-adapted system resilient to the effects of wildfire, insects, and disease. We realize there would be imbalances in the short-term related to an abundance of acres in VSS 2 - 3, and a deficiency in VSS 1. Over time, we would manage to correct this imbalance with a series of pre-commercial and commercial harvests designed to maintain old forest, yet regenerate enough young forest to eventually take its place as VSS 5 - 6 as trees grow from the VSS 3 and 4 into VSS 5 and 6. From stand exam data, trees growing with reduced competition consistently put on 2 inches of diameter growth per decade (1-inch radial). With average tree diameter in VSS 4 at 15-inches DBH (KNF I&I, v. 3, 2009), for example, growth into trees > 18-inches DBH (VSS 5) would occur within the 40 year maximum timeframe for analyzing effects of this project.

The Modified Proposed Action in the even-aged stands is basically a thinning from below to about 9-inches DBH with the option to remove larger trees if infested with disease, or a center of bark beetle activity. This treatment combined with controlled, prescribed fire would improve forest health, and move these acres into uneven-aged condition over time.

[14] **FVS** is used for predicting forest stand dynamics and is used extensively in the United States. The Central Rockies variant of the model was used for JR's geographic area. The data collected for the project was as recent as 2007, yet some of the stand data is 15 years or older. FVS is a tree growth model with the capability to update stand conditions to the year 2010. The FVS was used to simulate silvicultural treatments in 2010, and growth 45 years following treatment. FVS is a very good tool, but there is one major limitation to the model. FVS is density dependent which limits the ability to model openings created for uneven-aged management using group selection. FVS is not a spatial model.

2) Alternative 2 – No Action

The No Action alternative does not implement Forest Plan direction of promoting uneven-aged stands. By the year 2050, the even-aged stratum is not sustainable. There should be at least 20% of the acres in VSS 1-2 when uneven-aged conditions are following Forest Plan guidelines. With no harvest treatment or consequent seedbed preparation, regeneration would be minimal. Over time, the conditions would be such that there would not be enough seedlings and saplings to become the future mature forest, and replace ponderosa pine mortality in the VSS 5-6 classes. The direct effects of no pre-commercial thinning would result in high basal area (90), SDI (224), and trees per acre (822) in the year 2015. As a comparison, ponderosa pine stands are considered to be stocked and healthy at about 150 trees per acre. Under the No Action alternative, trees per acre remain over five times the desired level.

Forest health by year 2050 is even more compromised due to high SDI (311), 69% of maximum, well beyond the stand density level where competition induced mortality begins. The indirect effect of not thinning overly dense stands of ponderosa pine is tree mortality, increased fire risk, and site conversion when wildfire disturbs these areas. Due to periodic drought, presence of fire-adapted ecosystems in and adjacent to this project, the question is not if there will be a fire, but when.

Insect and disease conditions in the older trees would likely result in mortality from western pine beetle, roundheaded pine beetle, and dwarf-mistletoe. Group killing of trees by the western pine beetle is common in dense, overstocked stands of pure, even-aged ponderosa pine trees (Demars and Roettgering 1982). The roundheaded borer also works in conjunction with western pine beetle to attack stressed and weakened trees, and may kill up to 50% of trees in pure stands, both small and large diameter (Massey et al 1977). Trees weakened by moisture stress and bark beetles may also succumb to dwarf-mistletoe as foliage becomes thin, short and yellowish, and the top dies (Lightle and Weiss 1974). Dense stocking in the even-aged stratum could result in the loss of mature trees in VSS 5-6, with very little regeneration to replace old trees.

The No Action alternative could also result in type conversion of some stands in the Existing Nest areas. See Appendix A (Figures A-4 through A-6) for a visualization of Stand 0550118. The simulated wildfire was modeled under 90th percentile fire conditions derived from historic fire data on the NKRD (J. Erickson, AFMO/Fuels Specialist).

There is no way to predict where or when a wildfire may occur on the NKRD, but recent experience with the Warm Fire (2006) does prove that under dry conditions in densely stocked stands with low humidity, high temperatures and strong winds, stand-replacing crown fires do occur. The SVS models predict stand conditions in Site 0550118 if a wildfire were to happen. Appendix A (Figures A-4 through A-6), shows stand conditions before the fire, immediately after the fire in 2014, and at the end of the modeling period.

The remarkable aspect of these three simulations is the destructive nature of the fire in a relatively open stand. Type conversion is a risk if stand replacing wildfire occurs at 90th percentile conditions. Though 90% of the days during the fire season have less extreme fire weather, there is certainly a risk of destructive wildfire in some even-aged stands.

3) Alternative 3 – 16-inch Diameter Cap

The management strategy in these stands includes thinning from below to 16-inches DBH, retaining seed and shelterwood leave trees, and removing dense thickets of regeneration. With over 50% of even-aged acres in VSS 2, there would be a conversion of approximately 15%, by cutting out thickets to open areas for natural regeneration near seed trees.

Thinning up to 16-inches DBH improves growth and forest health conditions in even-aged stands. The indirect effects are manifested with improved forest health. The basal area, trees per acre and SDI are within healthy forest parameters, especially SDI. After treatment, SDI is 116 (26% of maximum), 34% of site occupancy, in year 2030, and 42% in year 2050 (about mid-range for site occupancy). All SDI metrics are well below the onset of self-thinning, about 57% of maximum.

Note the effectiveness of Alternative 3's 16-inch diameter limit in achieving desired stocking levels and stand densities in even aged stands. The Modified Proposed Action thins in even aged stands, cutting very few trees larger than 9 inches in diameter. But Alternative 3's diameter limit would retain shelterwood seed trees that are infected with dwarf mistletoe, thereby jeopardizing the future health of all nearby understory trees.

➢ **UNEVEN-AGED STANDS**

A major component of desirable goshawk habitat is the group and clump nature of the ponderosa pine forest. This project is designed to develop and maintain that component. Clumps with interlocking crowns maintain canopy within groups, and groups are categorized into vegetative structural stages by the plurality of basal area within the group. The balanced diversity of age and size classes across the landscape with uneven-aged structure is a major goal of the goshawk guidelines.

The Uneven-aged stands in JR cover about **19,004 acres** (including nest areas), and contain a variety of sites. All of this area is categorized as goshawk habitat, and is further subdivided into Foraging Areas, Post-fledging Areas, and Nest Areas. Existing Nest Stands comprise **~ 3,112 acres** of uneven-aged stands, and Replacement Nest stands another **1,417 acres**. The Existing Condition in these stands is an abundance of trees in all VSS classes.

In recent years certain public entities and other agencies have been confused or voiced concern regarding analysis measurements for VSS and canopy cover requirements in the Forest Plan for management of northern goshawk habitats. In some instances it is thought that the Forest Service has re-defined the standards and guidelines for management of the northern goshawk. It should be noted that the Forest Service does use stand quantification where applicable, such as in even-aged stands where a single VSS is present. To clarify the Forest Service position that the use of VSS group versus stand measurements and quantification are within plan guidance, an examination of the plan standards and guidelines for goshawk management has been completed and is summarized in an August 25, 2011 white paper, by Alvin Brown, Forest Silviculturist/NEPA Coordinator for the Kaibab National Forest (PR-60).

To meet Forest Plan recommendations for uneven-aged management (FP, pp. 29-30), the long term strategy is to keep VSS distribution in a balanced condition: *VSS 1 – 6 at 10:10:20:20:20:20 percentages respectively. The Forest Plan also requires retention of canopy cover within groups of VSS 4-6 as follows: Canopy cover for mid-aged (VSS 4), mature (VSS 5) and old (VSS 6) forests should average 40 percent or more, but only dominated by one of these VSS class determinations (i.e., VSS 4, 5 or 6). Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre, (including the downed logs).* [note: average size of opening or regeneration openings under Alternative 1 would be less than 1 acre in size; Alternative 3 would create some regeneration openings too, but only 20% or one-fifth of the number of openings as those which would be created under Alternative 1].

Point data collected with Common Stand Exam protocols were analyzed for VSS class, and these points were summarized to display the VSS distribution in the uneven-aged strata. See Table 5(a) for a

comparison of alternatives with VSS point analysis included. The points were analyzed for plurality of basal area, and summarized for the Uneven-aged strata. This process provides a general landscape description of structural diversity and proportions, and displays statistical summaries by VSS class. The point or plot is the small-scale analysis area. The mid-scale analysis area is the uneven-aged stratum displayed in Table 5(a). This process provides a general landscape description of structural diversity and proportions, and displays statistical summaries by VSS class.

Table 5(a). Vegetative Structural Stage analysis for Jacob-Ryan alternatives after implementation at (zero) 0, 20, and 40 time periods. (Uneven-Aged Strata).

VSS Distribution (Percent)	Alternative 1 Proposed Action			Alternative 2 No Action			Alternative 3 16 inch limit		
YEAR	**0***	**20**	**40**	**0**	**20**	**40**	**0***	**20**	**40**
VSS 1 (10)	9	9	9	**5**	5	5	6	5	5
VSS 2 (10)	13	4	2	**10**	5	3	7	1	1
VSS 3 (20)	18	21	18	**18**	18	20	16	17	18
VSS 4 (20)	20	20	20	**23**	22	19	22	22	19
VSS 5 (20)	20	20	19	**23**	24	24	26	26	25
VSS 6 (20)	20	26	32	**21**	26	29	23	29	32
***These VSS percentages for Alternatives 1 and 3 represent data after treatment.**									

The Proposed Action essentially balances VSS distribution to the desired condition, especially when VSS 1 and 2 are grouped together; desired is 20% compared to 22%. Additionally VSS 1 and 2 combined under Alternative 1 would be an improvement over the No Action or Alternative 3 VSS 1 and 2 combined totals, thus showing improvement. As trees grow and more acres of VSS 6 develop, we would need regeneration treatments to maintain the desired forest structure over time. For example, in the Proposed Action, acres in VSS 6 after 20 years could be converted to VSS 1 to increase VSS 1-2 to at least 17%.

Regeneration opportunities under Alternative 3 are limited. There would be about a 1% reduction (~ 145 acres) in VSS 4, by cutting small groups of trees up to 15.9" DBH. Due to VSS 3 percentage being at levels which are already less than desired condition (18%), there would be little-to-no opportunity to regenerate acres by cutting in this VSS class. Under the Proposed Action VSS 3 is below desired condition of 20% (but still within the allowance of plus-or-minus 3% according to the Forest Plan) just after treatment. However, progress trends towards desired condition within 20 years with the Proposed Action. Treatments under Alternative 3 would result in reduced acres in VSS 3 after treatment, which is outside the 3% tolerance allowed in the KNF Forest Plan, thus not meeting the intent of the Forest Plan and thus would require an amendment.

Under Alternative 1 (the Proposed Action) there is tree growth from VSS 3 and 4 into VSS 5 and 6, noted by an increase in VSS 6 to 32% and decrease in VSS 3 to 18% after 40 years. The model displays active movement of VSS classes over time with no intervening treatment. However, the model predicts when and where treatments are needed to balance distribution, and ensure future VSS 1. By regenerating 10% of VSS 6 acres after 40 years, VSS 1-2 would be ~21%, or desired condition. By comparison, the 16" diameter cap would produce a landscape of mature and over-mature trees (55% VSS 5 – 6 after 20 years and 57% after 40 years) with only 6% VSS 1-2 (at both the 20 and 40 year marks), with no means to regenerate areas of the future mature forest. Alternative 3 is essentially trending towards even-aged forest structure dominated by VSS 5-6.

Ad-Hoc Analysis Area: The large scale of analysis for VSS is the ad-hoc area, about **69,000 acres** of ponderosa pine forest including and surrounding JR (which includes both the even-aged and uneven-aged stratum). The No Action alternative would basically be considered status-quo, in that no treatment would take place, thus the No Action is the same as "before treatment" and is used as the baseline for comparison to the other two action alternatives. See Table 5(b) for VSS distribution in the ad-hoc or large scale analysis area, before and after the proposed treatment in JR.

Table 5(b). VSS percent distribution for ad-hoc area before and after regeneration treatments for JR.*

Ad-Hoc Area VSS Distribution (by percentage) Before & After Proposed Treatment * (note: ad-hoc area includes even-aged and uneven-aged strata combined)					
BEFORE TREATMENT – BASELINE (SAME AS NO ACTION)					
VSS 1	**VSS 2**	**VSS 3**	**VSS 4**	**VSS 5**	**VSS 6**
7.4	9.2	22.5	14.5	26.4	20.0
AFTER TREATMENT (ALTERNATIVE 1 – PROPOSED ACTION)					
9.8	7.8	22.5	14.3	25.8	19.8
AFTER TREATMENT (ALTERNATIVE 3 – 16-INCH DIAMETER CAP)					
9.0	7.8	22.5	14.3	26.4	20.0

This analysis of the ad-hoc VSS is required by the forest plan, and provides our best estimate based on best available science.

Under the Modified Proposed Action (Alternative 1) there would be **724 acres** of conversion of VSS 4-6 to VSS 1 in uneven-aged stands and **944 acres** in even-aged stands (1.4 % from VSS 2 to VSS 1) restored. These combined treatments would improve the existing VSS 1 by about 2.4 percent, and reduces the percentage in VSS 5 by 0.6 percent within the Ad-hoc analysis area. The impact from treatments under Alternative 1 are minor when analyzed at the larger landscape level, which for JR is the ad-hoc analysis area that includes an additional 41,492 acres of ponderosa pine type forest (see Vegetation Resource Specialist Report {2010 PR-29}).

Alternative 3 would also regenerate the **944 acres** in even-aged stands (1.4% increase in the ad-hoc VSS 1), but is would only regenerate **145 acres** (or approximately 0.2 percent decrease in VSS Class 4 within the 69,000 acres), which is a negligible change to the ad-hoc VSS distribution.

Regarding VSS 4, there would be no difference when comparing Alternative 1 to Alternative 3; there would be approximately 145 acres or 0.2 percent decrease under both action alternatives. However, regarding treatment within the VSS 4 class, Alternative 3 would be limited by the 16-inch diameter cap, whereas Alternative 1 would be able to also thin trees between 16 to 18 inches DBH.

Canopy Cover related to VSS Distribution: Both the Uneven-aged stratum with the JR project area and the Ad-hoc area include openings and VSS 1–3 forest, for which canopy cover is not applicable. In the Ad-hoc area, and the ponderosa pine forest in JR and surrounding areas, the estimated canopy cover applies only to groups of VSS 4 – 6. The points would need to be extrapolated to groups of forest in VSS 4 – 6 at this analysis level. The canopy cover measured at the point level varies from approximately 40% (current condition) to 70% (after 40 years). When combining FAs and PFAs in the Uneven-aged stratum, the canopy cover ranges from 45% to 60% through the modeling period. The canopy cover would have a wide range from 40% in VSS 4 – 6 groups, to more than 70% in nest areas and in dense forest on north facing slopes.

Canopy cover level throughout the ad-hoc analysis area either meets or exceeds the desired condition (i.e., 40 percent or more), except where past even-aged management and wildfire has removed VSS 4-6 groups. Examples of these wildfire areas in the ad-hoc area include the 1987 Willis Fire (~2,000 acres) and the 2001 Hidden Fire (~450 acres) (See Figure 5). It is estimated that canopy cover is at or exceeding desired conditions over 65% of the ad-hoc area. Wildfires and even-aged management have created deficient conditions over approximately 35% of the area. Both action alternatives under the JR project would maintain canopy cover at desired condition.

- **Direct and Indirect Effects**

1) Alternative 1 - Modified Proposed Action

The Modified Proposed Action is a restoration-based approach to forest management of southwestern ponderosa pine. Frequent, low intensity fires and lack of moisture maintained the ponderosa pine forest in an open condition with about 50 - 90 ponderosa pine trees per acre (Lang and Stewart 1910). With current tree stocking (i.e., number of trees per acre) at levels 10 times greater than the early 1900's, and five times greater than recommended levels (recommended level is ~ 150 trees per acre), commercial and pre-commercial thinning would be necessary to restore balance and forest health. Though it is not necessary, or even desirable in some cases, to replicate the condition of the pine forest that Lang and Stewart observed, it is both essential and desirable to change current conditions toward the more fire-adapted conditions that existed historically. It is essential to restore conditions resilient to stand-replacing wildfire, insect epidemics, and widespread disease, and desirable to sustain conditions that provide watershed protection, wildlife habitat, and a sustainable flow of forest products over time.

When dense concentrations of trees are thinned, tree growth improves with light, nutrients, and moisture more available on average to each remaining tree due to less competition. Ponderosa pine varies widely by location and site, but responds well to release treatments. Trees 5 to 20 inches DBH and from 19 to 36 years old can grow 4.9 inches in diameter per decade if free of inter-tree competition in central Oregon. Trees in a virgin stand in Arizona grew 1.14 inches per decade on average during a 10-year period, but trees in a cutover stand grew 1.68 inches (Silvics – Volume 1 Conifers 2004).

Ponderosa pine remains physiologically young and responds to release up to age 200 in Arizona. Elsewhere, stagnated sapling stands 70 to 100 years old usually respond to thinning and seem to grow as rapidly as non-stagnated trees, when crowns grow to sufficient size to take advantage of the additional growing space (Silvics – Volume 1 Conifers 2004). In the JR project area, diameter growth rates of 1.5 inches per decade were recently measured in areas where inter-tree competition was reduced. Given more open stands with adequate light, moisture, and nutrients, ponderosa pine can attain 18-inch DBH in about 120 years on moderate to good sites.

To best achieve these goals and meet Forest Plan requirements, the Modified Proposed Action reduces existing high tree densities in Goshawk FA's and PFA's. In accomplishing this aim, both SDI and BA are reduced to desired ranges. The ranges for SDI in both Goshawk PFAs and FAs developed for the JR project were disclosed during the scoping process. The original desired ranges were taken from the KNF I&I (USDA Forest Service 2009), which are intended only as recommendations which still allow flexibility for interpretation and implementation (Bruce Higgins, personal communication, 2010). The recommendations in the KNF I&I are also forest-based and not specific to the NKRD where there are more uneven-aged stands, larger trees, and excellent growing sites. With new information from FVS analysis, these SDI ranges were modified to account for site specific conditions on the NKRD. Desired ranges for basal area and SDI in Chapters 1 & 2 are well within parameters for good forest health and represent low to moderate stand densities in terms of site occupancy. (See Table 8 for desired ranges of SDI and BA and mortality.)

Identification of the desired treatment ranges for SDI and BA required consideration of the inter-relationship of these metrics in modeling treatments. Tables 6 and 7 below illustrate modeling results for similar treatments in the same Foraging Area stands; Table 6 is based on cutting to a "basal area" target, and Table 7 is cutting to an "SDI" target. Alternative 1 uses the basal area target for this entry as a more conservative approach to meeting purpose and need.

Table 6. Average summary tables for the FA in Jacob-Ryan with the Modified Proposed Action using a basal area target.

(Summary of)
FVS SIMULATION: JR_UNEVEN-AGED_FA_PROPOSED ACTION WITH BA TARGET
SIMULATION DONE: 11-30-2010 09:18:49

AVERAGE* SUMMARY STATISTICS BY COMMON CYCLE

START OF SIMULATION PERIOD											REMOVALS				AFTER TREATMENT					GROWTH THIS PERIOD		
YEAR	AGE	NO OF TREES	BA	SDI	CCF	DOM HT	QMD	TOTAL CU FT	MERCH CU FT	MERCH BD FT	NO OF TREES	TOTAL CU FT	MERCH CU FT	MERCH BD FT	BA	SDI	CCF	DOM HT	RES QMD	PERIOD YEARS	ACCRE PER	MORT YEAR
2010	18	852	124	283	98	69	6.5	2908	2681	13896	0	0	0	0	124	283	98	69	6.5	1	36	10
2011	19	838	126	285	99	69	6.5	2935	2705	14032	305	1346	1239	6525	70	161	57	56	6.8	4	33	2
2015	23	524	76	172	63	57	7.1	1710	1573	8116	0	0	0	0	76	172	63	57	7.1	5	33	3
2020	28	509	84	185	69	58	7.5	1860	1710	8846	0	0	0	0	84	185	69	58	7.5	5	34	4
2025	33	493	92	198	76	60	7.9	2014	1844	9544	0	0	0	0	92	198	76	60	7.9	5	36	5
2030	38	476	99	210	82	61	8.3	2170	1976	10219	0	0	0	0	99	210	82	61	8.3	5	38	6
2035	43	457	106	221	88	61	8.6	2329	2103	10856	0	0	0	0	106	221	88	61	8.6	5	39	7
2040	48	437	113	230	94	62	9.0	2492	2238	11454	0	0	0	0	113	230	94	62	9.0	5	40	9
2045	53	416	119	238	99	63	9.4	2649	2395	12012	0	0	0	0	119	238	99	63	9.4	5	41	10
2050	58	396	125	246	104	64	9.8	2805	2574	12525	0	0	0	0	125	246	104	64	9.8	5	43	11
2055	63	377	130	252	108	64	10.2	2965	2759	13002	0	0	0	0	130	252	108	64	10.2	5	45	13
2060	68	359	136	258	112	65	10.6	3128	2949	13440	0	0	0	0	136	258	112	65	10.6	0	0	0

Cutting to a basal area target as shown in Table 6 would maintain a minimum SDI of 35.7% of maximum (low end of desired range for site occupancy) immediately after treatment. Given the productive soils and the preponderance of large trees, SDI reflects the larger average stand diameters on NKRD. Maintaining uneven-aged FA stands at a minimum 35% of maximum SDI, as a fully stocked, healthy forest facilitates carbon storage by minimizing tree mortality, and maximizing site productivity and net primary production. These vigorous growth conditions promote resistance to insect and disease epidemics and high-severity wildfires.

Table 7. Average summary tables for the FA in Jacob-Ryan with the Modified Proposed Action using SDI target.

(Summary of)
FVS SIMULATION: JR_UNEVEN-AGED_FA_PROPOSED ACTION TREATMENT WITH LOW-END SDI TARGET
SIMULATION DONE: 10-19-2010 12:42:01

AVERAGE* SUMMARY STATISTICS BY COMMON CYCLE

START OF SIMULATION PERIOD											REMOVALS				AFTER TREATMENT					GROWTH THIS PERIOD		
YEAR	AGE	NO OF TREES	BA	SDI	CCF	DOM HT	QMD	TOTAL CU FT	MERCH CU FT	MERCH BD FT	NO OF TREES	TOTAL CU FT	MERCH CU FT	MERCH BD FT	BA	SDI	CCF	DOM HT	RES QMD	PERIOD YEARS	ACCRE PER	MORT YEAR
2010	18	852	124	283	98	69	6.5	2908	2681	13896	0	0	0	0	124	283	98	69	6.5	1	36	10
2011	19	838	126	285	99	69	6.5	2935	2705	14032	546	1775	1638	8501	50	109	39	50	6.5	4	29	2
2015	23	290	55	120	44	51	6.9	1269	1165	6060	0	0	0	0	55	120	44	51	6.9	5	30	2
2020	28	285	63	133	50	52	7.4	1410	1289	6714	0	0	0	0	63	133	50	52	7.4	5	32	2
2025	33	281	71	147	57	54	7.8	1558	1414	7363	0	0	0	0	71	147	57	54	7.8	5	34	3
2030	38	276	79	159	63	55	8.3	1711	1544	8018	0	0	0	0	79	159	63	55	8.3	5	35	4
2035	43	271	86	172	70	56	8.8	1869	1680	8653	0	0	0	0	86	172	70	56	8.8	5	36	4
2040	48	266	94	183	76	58	9.2	2028	1825	9267	0	0	0	0	94	183	76	58	9.2	5	37	5
2045	53	260	101	194	81	59	9.6	2189	1988	9851	0	0	0	0	101	194	81	59	9.6	5	39	6
2050	58	254	108	203	87	60	10.1	2352	2158	10413	0	0	0	0	108	203	87	60	10.1	5	40	7
2055	63	247	114	212	92	61	10.5	2518	2334	10955	0	0	0	0	114	212	92	61	10.5	5	42	9

Use of an SDI target as shown in Table 7 would result in basal area and SDI levels at the low end of desired ranges (Ranges are 55-80 ft^2/acre for BA and 112-180 SDI within FA's, and 70-90 ft^2/acre for BA and 135-190 SDI within PFA's; See Table 4 of EA) and the most open forest conditions compatible with desired ranges in this entry. These low end desired ranges would result in a forested condition that is more open than desired, leaving less groups and canopy cover on site. Comparing Table 6 and Table 7 shows that cutting to desired basal area in the FA as shown in Table 6 would still keep SDI within the desired range for 5-10 years after treatment. Cutting to a BA target as shown in Table 6, would be a lighter more conservative treatment, yet within desired ranges of BA and SDI, resulting in a forested condition that is conducive to natural regeneration, while meeting Forest Plan VSS distribution and canopy cover requirements.

Table 8 (below) describes the desired ranges for BA and SDI and mortality for Goshawk PFA's and FA's that resulted from the discussion referred to above. There is overlap in desired ranges for basal area and SDI to reflect the overlap of habitat areas in JR where adjacent FAs and PFAs are similar in terrain and site. Desired ranges will function as a guide to implementation on the ground where some adjacent areas are a blend of both habitat types.

Table 8. Comparison of Alternatives for 0 (after treatment), 20, and 40 year time marks for PFAs and FAs.

Forest Health Measures – for PFAs (Range of Desired Values)	**Alternative 1 Proposed Action**			**Alternative 2 No Action**			**Alternative 3 16 inch limit**		
Time in Years	**0**	**20**	**40**	**0**	**20**	**40**	**0**	**20**	**40**
Basal Area (70-90 ft2/ac)	87	113	134	**131**	154	171	106	128	144
Stand Density Index (135-190)	189	229	256	**300**	333	350	219	250	268
Mortality (less than 7 ft3/ac/yr)	3	7	11	**7**	11	13	4	8	11
Forest Health Measures – for FAs (Range of Desired Values)	**Alternative 1 Proposed Action**			**Alternative 2 No Action**			**Alternative 3 16 inch limit**		
Time in Years	**0**	**20**	**40**	**0**	**20**	**40**	**0**	**20**	**40**
Basal Area (55-80 ft^2/ac)	76	106	130	**128**	152	169	100	122	140
Stand Density Index (112-180)	172	221	252	**289**	322	340	206	240	260
Mortality (less than 7 ft^3/ac/yr)	3	7	11	**7**	11	15	4	8	13

Alternative 1 would reduce existing high tree density in FA's and PFA's improving forest health, and stand growth. It would successfully reduce basal area and SDI to their desired ranges, which is not achieved by Alternative 3. SDI would meet forest health objectives under Alternative 1. After treatment, the forest would be at 38 percent of maximum SDI with restored conditions in ponderosa pine forest in the FA's. The PFAs would be 42 percent of maximum SDI with resilience to insects, disease, and crown fire in critical habitat areas. The direct benefits of increased light, moisture, and nutrients would promote healthy and vigorous groups of ponderosa pine in open-grown conditions.

Under Alternative 1, the SDI level remains within recommended site occupancy levels (35% - 55%). Most likely, there would be a follow-up treatment in 2030 to bring SDI and BA back into desired ranges. Mortality levels would be low as improved growing space resulted in healthier trees.

In the FA (Table 8) basal area immediately after treatment would be 70, at the upper end of the desired range. By comparison, in the recent Fracas project on NKRD, residual basal area was 118 based on monitoring via fixed plots. The Fracas project had a 16-inch diameter cap, which did not allow the District enough flexibility to reduce basal area to desired forest health levels, 60 - 70 in the FAs, and 80-90 in the PFAs. That is why residual basal area in Fracas after treatment is high enough to justify a follow-up commercial treatment in trees > 16-inch DBH to attain good, forest health. Good forest health equates to resistance to insects, disease, and stand-replacing wildfires in the crown.

Alternative 1 essentially balances VSS distribution to the desired condition, especially when VSS 1 and 2 are grouped together; desired is 20 percent (%) compared to VSS 1-2 at 22 % (see Table 5(a), above). As trees grow and more acres of VSS 6 develop, the uneven-aged areas within JR would need regeneration treatments to maintain the desired forest structure over time. As an example, VSS 6 grows to 26% after 20 years while VSS 1 (9%) stays the same and VSS 2 declines from 13% to 4%. From post treatment at year 0 to year 20, VSS 1 and VSS 2 combined drop from 22% to 13%. At year 20, VSS 2 is furthest from the desired condition (4% existing vs 10% desired). To address this deficit it is necessary to convert at least 3% or 4 % of VSS 6 to VSS 1. This will maintain VSS 6 within the desired range and create more VSS 1 that can grow into VSS 2, thus moving towards desired conditions.

2) Alternative 2 – No Action

The No Action scenario would not move the area toward Desired Condition. See Table 12 in Vegetation Report (PR-29) for the summary statistics for the FVS model run from present until 2050. Under No Action, average trees per acre (TPA) would remain well above the recommended level of ~140, resulting in very slow growth rates, as evidenced by a mere 2.3-inch increase in average stand diameter over 45 years. The desired range for basal area in FAs (55-80 ft^2/acre) would not be achieved under this alternative any time during the analysis period. SDI would remains well above 260 for the entire period. Analysis indicates self-thinning mortality would occur, with a reduction in TPA from 852 in 2010 to 575 by year 2050. In five years, SDI would be 67% of maximum, well into the range of competition-induced mortality. Excessively high basal area (131 sq. ft. per acre) would pose great risk from bark beetle attack (Amman et al 1989, Harrod et al 1999). Even without major disturbance, analysis indicates mortality would double over the next 40 years. Eventually, though, some disturbance would occur in this project area, in the form of insect or disease attack, wind throw, or crown fire. It seems likely that at least one major disturbance would occur during the next 40 years, and without any treatment to reduce stand density, the effects of that disturbance would be catastrophic for most stands in this project area, posing the potential for their conversion from forest vegetation to grass or brush.

Another group of stands critical for northern goshawk habitat is the **~3,112 acres** of existing nest stands. See Table 9 for an indication of effects that would occur in nest stands under No Action, if wildfire occurred during the analysis period. Goshawk nest stands are currently in poor health, and would deteriorate under No Action. SDI levels would rise from 66% to 78% of maximum capacity or threshold, which is 450 SDI for ponderosa pine type forest. It is likely that disturbances, such as wildfire or bark beetle attack, would occur in nest stands over the next 40 years. These disturbances would have more severe effects due to the lack of any treatments over the next forty years, which would help reduce stand density.

Table 9. Average summary table for existing nest stands in Jacob-Ryan uneven-aged with no action through 2055.

(Summary of)
FVS SIMULATION: JR_UNEVEN-AGED_EXISTING_NESTS_NOACTION
SIMULATION DONE: 10-19-2010 14:50:07

AVERAGE SUMMARY STATISTICS BY COMMON CYCLE

START OF SIMULATION PERIOD											GROWTH THIS PERIOD		
YEAR	AGE	NO OF TREES	BA	SDI	CCF	DOM HT	QMD	TOTAL CU FT	MERCH CU FT	MERCH BD FT	PERIOD YEARS	ACCRE PER	MORT YEAR
2010	19	895	130	299	101	71	6.0	3103	2864	14839	5	34	6
2015	24	869	136	309	107	71	6.3	3244	2990	15536	5	33	7
2020	29	840	142	318	112	72	6.5	3377	3110	16177	5	33	7
2025	34	813	148	327	116	73	6.7	3509	3226	16778	5	32	8
2030	39	784	152	333	120	73	6.9	3628	3333	17352	5	32	9
2035	44	758	157	339	123	74	7.2	3742	3433	17896	5	31	10
2040	49	729	161	343	126	74	7.4	3844	3523	18411	5	30	11
2045	54	701	164	346	129	74	7.6	3941	3626	18881	5	30	13
2050	59	672	167	348	131	75	7.9	4029	3728	19283	5	30	13
2055	64	645	170	350	133	75	8.1	4113	3823	19660	0	0	0

The important features that nest stands offer in terms of old forest, large trees, and uneven-aged, multi-storied structure need to be sustained. But Figures A-7 through A-9 (in Appendix A) indicates the severe long term effects *if* a wildfire did occur in Stand 0540011. It would likely require many decades for this stand to return to pre-fire conditions. It seems likely that parts of Stand 0540011 would convert to grassland if there were no treatment to re-establish ponderosa pine, or if such treatments were ineffective due to wildfire effects on soils and lack of any remaining seed sources. Figures A-7 through A-9 show a minimal component of aspen in Stand 0540011, but the preferred forest type for goshawk habitat on the NKRD is ponderosa pine.

Given the potential effects of No Action on Stand 0540011, the nest areas that remain on NKRD after the Warm Fire have even greater importance, and may require special attention for many decades. The No Action alternative is virtually incompatible with that need.

3) Alternative 3 – 16-inch Diameter Cap

While the Modified Proposed Action would follow management direction in the Forest Plan, and reductions in stand density and disease levels would improve or maintain forest health. Alternative 3, with its 16-inch diameter limit, would not balance VSS distribution and would be outside the desired ranges. Therefore, the 16-inch diameter limit is not consistent with Forest Plan direction, and would require a Plan amendment.

Alternative 3 would implement thinning from below up to 15.9 inches DBH. This treatment would not bring basal area or SDI within desired ranges at any time during the next 45 years. As indicated in the comparison table (Table 8) above, basal area would remain high from immediately after treatment all the way until 2050 (100 – 144). SDI would stay well and above the desired range (135 – 190) that entire time and would reach self-thinning levels in about 22 years, when SDI = 252. Additionally, 6 years after treatment, when average BA reaches 110 or greater, there would be an increased risk of infestation from tree-killing bark beetles (Amman et al 1989).

Also, based on existing stand densities and fuel loading in uneven-aged stands current fire hazard conditions are high, which could facilitate the transition of surface fires into the upper canopy, promoting

destructive crown fires. Some values at risk due to high stand density and crown fires include forest health, desired forest structure, wildlife habitat and watershed function. The reduction or loss of these values may weaken or destroy the functionality of the forest ecosystem. Fielder et al (2002) found that a comprehensive, ecologically-based treatment, that considered the density, structure and species composition, was superior to prescriptions that focused only on the size of trees removed. Their study also found that long-term reductions in fire hazard were negligible, and stands thinned from below would need fire hazard reduction treatments after 30 years.

Under Alternative 3, with SDI at 47 percent (%) of the maximum, the forest health would be favorable for about five (5) years, after which tree stocking would steadily increase to self-thinning levels in about 30 years in Foraging Areas. By comparison, under the Modified Proposed Action, SDI does not reach the self-thinning level until the very end of the modeling period (i.e., 40 years following treatment).

- Diameter Caps and Treatment Longevity - Fracas Project Example

The Fracas Wildlife Improvement project implemented thinning from below with a 16-inch diameter limit. Plot data was gathered within the Fracas project area to prepare for a pre-commercial thinning prescription. The results of the commercial treatment were that residual basal area was 118 square feet, and there were about 480 trees per acre. The average diameter for trees larger than 5 inches in diameter was 19.5 inches (Fracas plot data, Personal Reconnaissance). The stands were densely stocked with large trees, and many areas were devoid of regeneration and forage production. At Fracas, the diameter cutting limit negated the Forest Service's ability to manage or restore the ponderosa pine ecosystem and promote uneven-aged structure. See the photograph on the next page (Figure 10) in the Fracas treatment area that had a 16-inch diameter cutting limit.

In contrast to a 16-inch diameter limit or cap, the Modified Proposed Action would create gaps or irregular spacing within stands. And based upon theses gaps or irregular spacing and creation of regeneration group openings, the mosaic patterns and open, uneven-aged forest character would persist for over 30 years following the initial treatment (under Alternative1). The VSS 3 tree groups would develop interlocking crowns and closed forest canopy within the first two decades following treatment (based upon residual density ranges and average growth rates, Ronco et al. 1985), and the VSS 4-5-6 tree groups would remain closed canopy following treatment (based on treatment objectives). However, the VSS 1-2 regeneration would not fully occupy the created openings or develop to a height approaching the 2/3rds of the general forest canopy until tree age 40-60 years, maintaining the canopy gaps during this period. Therefore the desired forest structure biological diversity and crown fire hazard reduction effects would be evident for at least 30 years following the proposed treatment.

Figure 10. Dense stand of blackjack timber[15] after harvest in the Fracas project.

Figure 10 above is of the recent Fracas project which was recently implemented and completed on the NKRD; the project included a 16-inch diameter cap on trees to be harvested, resulted in a dense overstory and very high density (118 sq. ft.) of basal area per acre. There were no openings created for regeneration, and a scarcity of seedlings and saplings in dense groups of large, ponderosa pine. Over time, the Fracas project area will resemble an even-aged, two-storied stand susceptible to crown fire and bark beetle infestation, unless it is re-treated in the near future.

- **SNAGS AND DOWNED, WOODY DEBRIS (DWD)ANALYSIS**

The Forest Plan guideline is 2 snags per acre, and 5 -7 tons per acre of downed woody debris. Current conditions do not meet this recommendation, but could be created with management practices including, prescribed and managed fire, and "living snags." Alternative 1 would meet snag and woody debris for all three time marks. For Alternative 3, enough snags and woody debris could also be produced to meet the Forest Plan guideline. See Table 10 for an analysis of snags and woody debris in JR uneven-aged stands.

Table 10. Snags and downed, woody debris in JR uneven-aged stands at three time marks.

Snags & Downed, Woody Debris	Alternative 1 Modified Proposed Action			Alternative 2 No Action			Alternative 3 16-inch Diameter Cutting Limit		
YEAR	**0***	**20**	**40**	**0***	**20**	**40**	**0***	**20**	**40**
SNAGS (tpa)	***2.0***	***2.0***	***2.0***	***1.1***	***1.4***	***1.9***	***2.0***	***2.0***	***2.0***
DWD (tons/acre)	***5.0***	***5.3***	***6.3***	***4.1***	***5.0***	***6.9***	***5.0***	***4.9***	***6.2***
* Year 0 represents conditions after treatment, realizing the treatment period could extend for a number of years.									

[15] Blackjack timber is young-growth southwestern ponderosa pine trees (with furrowed black bark)

Currently, average snag density in uneven-aged stands is 1.1 snags/ac, and 4.1 tons/ac of downed, woody debris. Past management activities, especially commercial and pre-commercial thinning, resulted in healthy stands that lack old growth features like decadence which is measured in snags and downed, woody debris.

To achieve desired conditions for snags and downed, woody debris, a combination of natural and man-caused actions such as prescribed fire to recruit snags would be implemented, this historically has resulted in post-burn mortality (i.e., 5 percent (%) or less in snag-sized trees). Cull trees are another group of snags that would contribute to Plan requirements as "living snags." Technically, this tree is alive and is not counted as a snag in FVS analysis. However, these trees have cavity nests, or extensive cat faces, or crown less than 5%, or extreme mistletoe disease, or a combination of these features that will cause mortality. These trees would be retained during harvest treatments because they are cull trees and have no usable timber volume, which means they could be utilized by small mammals and birds as potential habitat.

The ad-hoc area is sufficient in coarse, woody debris due in part to the effects of the fire use portion of the Warm Fire area. The ad-hoc area has ~2 snags/acre, 3 downed logs/acre, and 9-10 tons per acre of downed, woody material. (See final *Vegetation Management Specialist Report*, 2011.)

- **OLD GROWTH ANALYSIS**

What is Old Growth? The Forest Plan describes Old-Growth as the last stage in forest succession. Old-Growth habitat is the sum of physical and biological components of old growth forest that are essential to maintaining populations of certain old growth dependent species of wildlife. Old Growth as defined by the Forest Plan includes VSS 5 and 6 and other associated characteristics such as tree age, downed woody material, snags etc. (See Forest Plan pages 32-34, and table 15 for old growth standard and guidelines and characteristics). It is not solely defined by presence of large diameter trees.

Old growth forest structure also includes accumulations of large, dead and fallen trees, and decadence in the form of broken or deformed tops, and diseases (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 fire) can keep forests in early to mid-seral stages and delay the onset of "old forest" features. In the arid Southwest, important historical features of ponderosa pine forests were high-frequency or low severity fires, and varied patterns of tree establishment. This resulted 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, rather than stands, and so are very analogous to Vegetative Structural Stage (VSS) Groups as defined and used in the Forest Plan.

The standard for old growth in the Forest Plan is to manage for 20% of each cover type [within each forested Ecosystem Management Area (EMA) or landscape, see table 11 below] in old growth conditions as described on page 34 of the Forest Plan. The Forest Plan standard calls for the allocation consisting of landscape percentages meeting old growth conditions and not specific acres. The applicable scale at which this standard (i.e., 20% of each forested Ecosystem Management Area) applies is at all scales, which for JR is the Project area, the Ad-hoc analysis area, and GA 13. (See section 3.1 for detailed discussion of Ad-hoc analysis area and scales of analysis).

Table 11 data summarizes estimated old growth by cover type within Geographic Area (GA) 13 on the North Kaibab District. These estimates pre-date the Warm Fire in 2006. There were about 59,141 acres of old growth before the fire in GA 13. See Table 12 for a breakdown of the post-fire VSS from the analysis supporting the Warm Fire FEIS.

Table 11. Estimated amount of Old Growth (OG) within Geographic Area (GA) 13 on the North Kaibab Ranger District.

Cover Type →	Ponderosa Pine	Quaking Aspen	Mixed Conifer (included Spruce/Fir)	Grand Total (Total of all Cover Types)
Total Acres by Cover Type	175,710	22,025	51,050	248,785
Existing OG with GA 13	**43,767**	10,480	4,894	59,141
Percentage of Area by Cover Type that are OG	**24.9%**	47.6%	9.6%	23.8%

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

Data collected by TEAMs in the Warm Fire EIS was used to determine how much old growth was lost after the 2006 Warm Fire. The suppression area (~39,000 acres) contained about **9,300 acres** (~24%) of old-growth **before the fire**. Table 12 displays the VSS 5-6 percentages after the fire in ponderosa pine and mixed conifer. The ponderosa pine type after the burn was 11,900 acres (Warm FEIS 2009) with about 22% remaining in old-growth, or **~2,600 acres**. There was no old growth left in mixed conifer stands after the Warm Fire burned through them as a stand replacing crown fire. There was only ponderosa pine and mixed conifer types in the suppression area, and therefore, no aspen old growth in the Warm Fire area. ***The estimated loss of old growth in the Warm Fire suppression area is 9,300 acres minus 2,600 acres or approximately 6,700 acres***.

Table 12. Post-fire percent of ponderosa pine and mixed conifer VSS within the Warm Fire suppression boundary.

VSS	Successional Stage	Ponderosa Pine % of project area	Mixed Conifer % of project area
1	Grass-forb/shrub (non-stocked)	61	92
2	Seedling/sapling	0	0
3	Young forest	7	4
4	Mid-aged forest	9	4
5	Mature forest (18" – 23.9" DBH)	10	0
6	Mature forest (24"+ DBH)	12	0

(Data prepared by T.E.A.M.s; EIS Warm Fire 2009)

<u>The old-growth acres or allocations at three levels of analysis, adjusted for the Warm Fire, are as follows:</u>

- ~ **5,685 acres in the JR Project area**, or 21.1% of the project area.
- ~ **16,300 acres in the EMAs (JR ad-hoc area)**, or 24 % of ad-hoc area.
- ~ **52,440 acres in GA 13** (after accounting for loss from the Warm Fire), or 21.1% of the large geographic area.

Within the JR project area, there are approximately 5,685 acres of Old Growth forest within the Uneven-aged stratum and the Nest Areas of the ponderosa pine type (approximately 19,004 acres total). Based on table 2 of this EA, percentages or ratios can be calculated for VSS 5 and 6 grouped within the uneven-aged forest type for ponderosa pine. Within the proposed treatment areas of uneven-aged PFA and FA habitat, roughly 44% of that area or approximately 6,397 acres is classified as VSS 5

and 6. If old growth were literally defined as VSS 5 & 6 only, then this would equate to over 25% of the Jacob-Ryan treatment area as old growth. But as explained above and as indicated on table 15 of the Forest Plan (FP, p. 34), there are many other "characteristics" which have to be considered to meet old growth criteria. These VSS 5 and 6 allocation of percentages by acres above do not account for 80% of the old growth within the JR project area that exists in nest areas (approximately 4,529 acres) as well as any old growth that exists on steep sloped areas (848 acres). [note: Per table 15 of the Forest Plan, VSS class 4 groups may contains groups of trees greater than or equal to 14 inches DBH (yet less than 16-inches DBH) which could be 180 years old (i.e., a low site index) and meet old growth habitat and structural charateristics as described in Table 15 of the Forest Plan (FP., p. 34). If a portion of these VSS 4 groups were considered old growth, then the actual allocation of old growth percentages would be slightly higher than those estimated percentages presented above.]

Under both action alternatives, nest stand areas will be thinned from below (only up to 12-inches DBH) to aid in the development towards a structure of large trees. This activity will not result in a change in the amount of old growth under either action alternative. Nest stand areas compose approximately 80% of all old growth within the JR project area; under the Forest Plan, goshawk nest sites are considered de-facto allocations of old growth (FP, p. 32). The remaining 20 % of old growth (i.e., approximately 1,156 acres) within the JR project area is dispersed amongst the 14,475 acres of uneven-aged stratum.

Under Alternative 1, within the uneven aged strata outside nest areas, there would be **724 acres** of regeneration which converts 5% of the VSS 4-6 acres to VSS 1. Of the 724 acres of regeneration openings to be created under Alternative 1, 1% (or 145 acres) of that 5% being regenerated is made up of VSS 4, thus only 579 acres falls within VSS 5 and 6 classes. The following is an estimate of how much old growth could potentially be affected within that 579 acres (of VSS 5 and 6 class) under Alternative 1:

- Percentage or ratio of old growth within JR project area = 5,685 acres of old growth / 26,916 acres. This equates to 21.1%.
- **5,685 acres** of old growth within the JR project area, **less 4,529 acres of old growth** existing within the Nest Stand areas, **leaves 1,156 acres of old growth within the Uneven-aged stratum**.
- Per table 2 of the EA, there are **6,397 acres of VSS 5 and 6, within the Uneven-aged PFA and FA habitat.**
- The percentage of the amount of old growth within the Uneven-aged PFA and FA habitat can be calculated as 1,156 of old growth / 6,397 acres of VSS 5 and 6 = 18 %. If applied as a direct ratio, 18 % of the 579 acres of VSS 5 and 6 (being regenerated to VSS 1) would be considered old growth **(18% of 579 acres = 104.6 acres; or ~ 105 acres total).**
- **Percentage of old growth within project area to potentially receive treatment.** 105 acres of old growth / acreage with JR project area (26,916) = **0.39 %; ~ 0.4 %**.

Under Alternative 1, some selective harvest will occur within VSS 5 and 6 groups, however the overall allocation of percentage of old growth areas would remain at approximately 21%. Some of these groups are not classified as old growth based on the Forest Plan definition. However, overall percentage of old growth areas within the project area would remain at approximately 21% post-treatment. Due to regeneration of VSS 5 and 6, a reduction of old growth of up to 0.4 % may occur under Alternative 1. Based on the possible reduction of old growth up to 0.4%, the percentage of old growth within VSS 5 and 6 groups may drop from 21.1 to 20.7 % within the JR project area. This reduction would be even less measurable, when evaluating the potential impact at the mid-scale and upper scales of analysis (for instance 105 acres of the 16,300 acres equates to approximately *0.15% reduction* at the ad-hoc level, and 105 acres of 52,440 acres equates to approximately 0.04% reduction at the GA level.). However, it would be possible to minimize this reduction through the application of silvicultural prescriptions using selective

thinning, or group selective thinning, to keep enough old, large trees, and basal area and canopy cover to retain those VSS 5 and 6 groups with old growth characteristics, where applicable.

However, Alternative 1 (The Modified Proposed Action) minimizes this reduction in old growth (mainly in PFAs) through the use of silvicultural prescriptions using selective or group selective thinning to keep enough old, large trees and basal area to retain those VSS 5 and 6 groups with old growth characteristics. These prescriptions will meet Forest Plan standards.

The Forest Plan desired range for VSS 5 and 6 combined within the uneven-aged strata is between 34-46%. Under Alternative 1, VSS 5 and 6 (combined) increase from 40% following treatment, to 46% in 20 years, then to 51% in 40 years. Under Alternative 3, VSS 5 and 6 combined increase from 49% following treatment, to 55% in 20 years, then to 57% in 40 years [EA, table 5(a)].

The Forest Plan also states that in allocating old growth and making decisions about old growth management, that decisions are made using appropriate information about risks to sustain old growth function at appropriate scales, due to natural and human caused events (Forest Plan p. 33).

The direct effects of a crown fire are devastating to the development and progression of the forest toward uneven-aged conditions and the sustaining of old growth. Recent fires in the southwestern U.S. have shown the effects of uncharacteristic crown fire in dense forest stands. The Warm fire is a good example of what the effects of a catastrophic wildfire are within the ponderosa pine type forest. This fire occurred directly south of the JR project area, with much of the fire affecting similar dense forest type as that which is proposed for treatment under JR (See Figures 6 and 9). About 12,000 acres of ponderosa pine burned as a stand-replacing fire with 100 percent mortality.

The Warm Fire created even-aged stand conditons over 70% of the area when the ponderosa pine and mixed conifer areas are combined. Large-scale shifts in forest structure in the Warm Fire make JR project implementation essential to provide stand replacing fire resistance in the future. The Warm Fire combined with the nearby Willis, Hidden, and Big fires represent similar landcape areas that are now even-aged.

It is important to note that Alternative 1 utilizes 724 acres of regeneration openings to create small gaps between groups that serve as fuel breaks and encourage canopy fire to drop to the ground. On average, these openings would be 1 acre or less in size. This action would help to prevent stand replacing crown fires similar to what occurred in the Warm Fire.

Alternative 3 is limited by the diameter cap to creating only 145 acres of regeneration openings in the uneven aged strata allowing for more continuous canopy cover that is less resistant to running crown fire. Under alternative 3, the diameter cap will restrict the ability to reduce forest density leaving the forest more prone to risk from disease, drought and other forest health stressors than Alternative 1. Under Alternative 3, these dense forest conditions place existing old growth at greater risk of stand replacing fire and insect epidemic than Alternative 1.

- **CUMULATIVE EFFECTS**

Since the forest is a renewable resource, forest vegetation and canopy cover typically return to pre-thinning levels within about 20 years. Given this time frame, the temporal boundaries for analyzing the cumulative effects of this project on vegetation extend from about 20 years ago to about 20 years into the future. Based on that timeframe, this analysis of cumulative effects includes commercial treatments from 1989 through the present, along with reasonably foreseeable future projects 20 years into the future. Note that most projects that are more than five years into the future are not reasonably foreseeable at this time,

and virtually no projects more than 10 years away are reasonably foreseeable now. See Table 13 for a summary of the acres and treatments in the JR area.

Planned, foreseeable actions would include the implementation of the JR project, as previously described in this document. Another project that would be proposed soon within the boundaries of the JR project is approximately **771 acres** of thinning in the wildland urban interface (WUI) areas around Jacob Lake (Plateau Facilities Fire Protection Project). The purpose of this treatment is to protect existing structures or developments and improve forest health.

The major, adjacent cumulative effects area is the Warm Fire Use and Ad-Hoc areas. See Figure 11 and Table 13 for a summary analysis of the Ad-Hoc area. The Wildland Fire Use project in 2006 was a product of the Warm Fire natural ignition that was managed on the surface and monitored in order to treat about **19,000 acres** for resource benefits. The fire use project beneficially treated about 90 to 95 percent of those acres before high winds allowed the fire to escape and forced it to be put in a suppression mode. The Warm Fire Use project reduced fuel loads across its acreage and increased the understory grass component of the area. Currently the project area is made up of late seral vegetation in the overstory with a stable grass/shrub understory. A good share of the credit for the beneficial resource treatment is due to some of the previous shelterwood treatment areas which served to drop crown fires back to the ground surface. Three years following treatment, this acreage has stabilized with good understory vegetation and would not cumulatively impact the JR project.

The Warm Fire Use area had been previously treated with Individual Selection, Group Selection, Group Shelterwood, and Intermediate harvests. Past treatment acres since the late 1980's in the Ad-Hoc and Warm Fire Use areas included about **5,900 acres** of harvesting. Because these acres were harvested, Fire Use was considered a viable option to burn accumulated fuels in the understory, thin understory trees with fire, and return nutrients into the soil. When the fire reached thick stands of mixed conifer in steep areas, it became a crown fire, and was declared a wildfire. The wildfire area was about **39,100 acres**.

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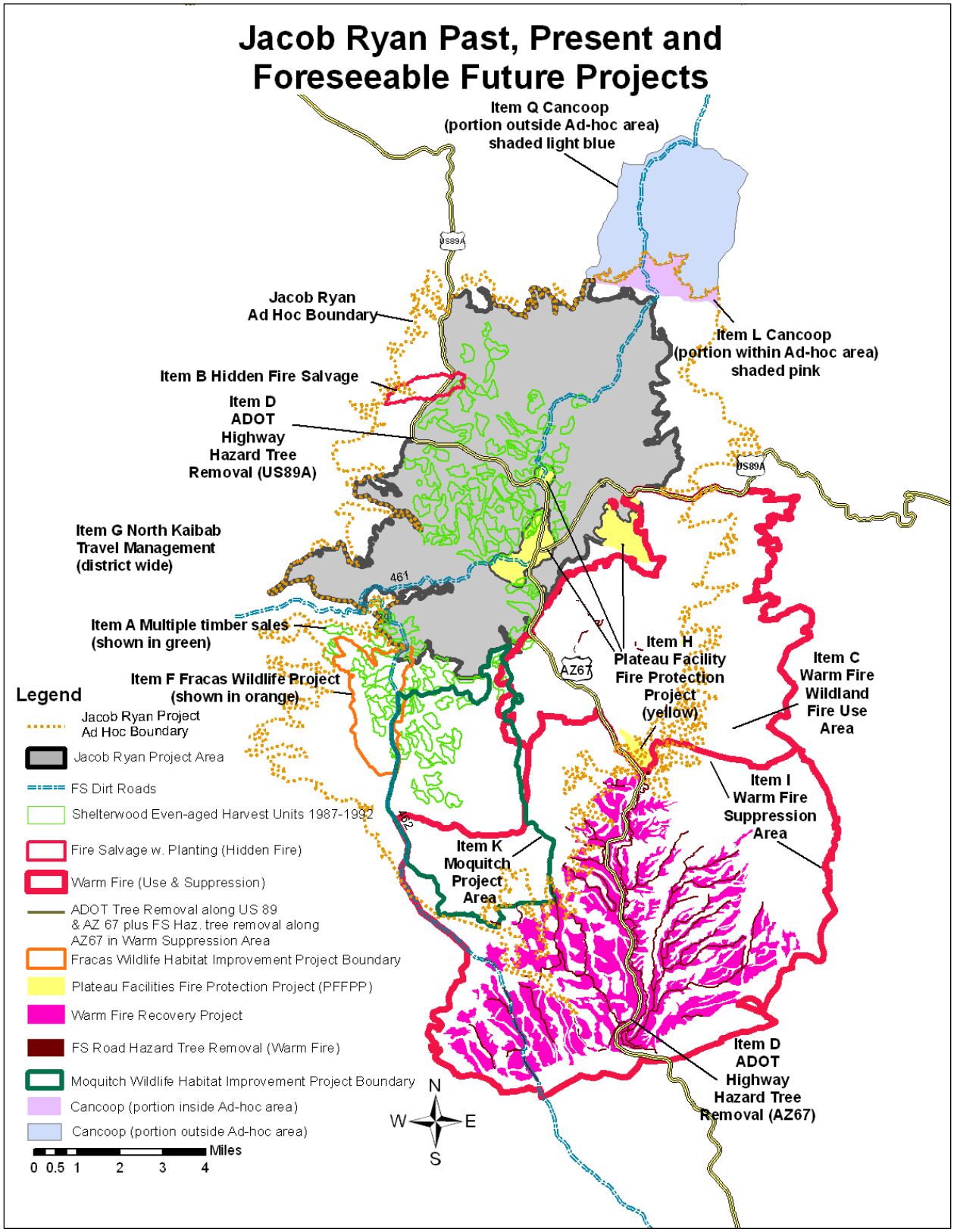

Figure 11. JR Cumulative Effects / Ad-Hoc Analysis Area Projects Map

Table 13. Cumulative Actions Table for past, present, and foreseeable future actions within the JR ad-hoc analysis area.

Cumulative Actions Table						
Past, present, and foreseeable future actions in the Ad-Hoc Analysis Area for JR						
Item	**Project Name**	**Project Type & Date/Year**	**Acres**	**Project Description/Effects**	**Current Condition**	**Desired Condition**
A	Multiple timber sales	Even-aged shelterwood and seed tree harvests 1989 - 1992	1,970	Multiple timber sales using even-aged shelterwood cut and seed-tree cut regeneration harvest methods. Effect is dense tree stocking due to natural regeneration, which when added to JR adds **1970 acres** of even aged condition or **8270 acres** that are not in desired condition for goshawk emphasis for uneven-aged condition and VSS % distributions in the current condition. Treatments in the even-aged stratum of JR begin to correct this condition on the **6,293 acres** of even-aged stratum which is a 9% improvement over current condition.	Most acres consist of high densities of VSS 1-3 with spaced individual VSS 5/6 seed trees	Uneven-aged stands with openings and ground cover.
B	Hidden Salvage	Fire salvage 2001	464	Hidden Fire salvage in analysis area. Snag retention maintained on steep slopes. Ponderosa pine planted on salvage acres Reforestation benefit on planted areas, and oak sprouting.	Even-aged where planted in VSS 1&2. Heavy gambel oak regeneration with grass and shrubs. Some VSS 4-6 overstory remaining.	Uneven-aged ponderosa pine sites
C	Warm Fire Wildland Fire Use	Wildland fire use from lightning ignition 2006	19,000	Warm Fire use area managed on the surface for resource benefits on about **20,000 acres**. Reduced tree densities with surface fire, and forage production of grass, forbs, and shrubs. When considered with the JR project, adds **19,000 acres** in a more desired condition for goshawk structure, snags, logs and DWD. When added to JR, provides **34,000 acres** actively progressing toward goshawk condition.	Late seral vegetation in place	Reduction in fuel loading and increases in grass, forbs and shrubs
D	ADOT Highway Hazard Tree Removal	Hazard tree removal along highway right of ways 2007	300	Arizona Dept. of Transportation (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. Cumulative benefit by reducing fire threat to JR due to more openings, and fire resistant species.	Early seral vegetation in place. 100 foot open buffer either side of highway for visual safety	Grass/forb/shrub vegetation in the 100 foot buffer both sides of highway.
E	Forest Service Road Hazard Tree Removal	Hazard tree removal along FS roads and AZ Trail burned in Warm Fire Use Area 2009	60	Hazard tree removal along FS roads and trails for public safety following the Warm Fire Use Area burn; about 3% of project. Cumulative benefit with aspen regeneration and more fire resistant acres. **Adds 60 acres** of fuel breaks along key roads near JR.	Ongoing about one-half completed with removal of dead burned trees leaving remaining green trees.	Removal of standing dead trees along FS roads.
F	Fracas Wildlife Project	Wildlife habitat improvement project 2009	2,000	Habitat improvement project to thin ponderosa pine followed by under burning for area wildlife Cumulative benefit when added to JR that provides an additional **2000 acres** of treated area within the ad-hoc area progressing toward goshawk guidelines.	Vegetation management ongoing	Fire adapted uneven-aged stands in ponderosa pine

Cumulative Actions Table						
Past, present, and foreseeable future actions in the Ad-Hoc Analysis Area for Jacob-Ryan (con't)						
Item	**Project Name**	**Project Type & Date/Year**	**Acres**	**Project Description/Effects**	**Current Condition**	**Desired Condition**
G	North Kaibab Travel Management	District-wide Travel Management 2011 > future	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. No effects anticipated.	EA that identifies the proposed road system on district.	Sustainable motorized road system
H	Plateau Facility Fire Protection Project	Facility Fuels Reduction project on Kaibab Plateau 2011/2012	~1593	North Kaibab Plateau facility and urban interface fuels reduction project designed to protect multiple stakeholders, their property and ensure public safety from wildfires A portion of the **5081 acre project** is within JR (833 acres) and the ad-hoc analysis area The project will add beneficially to the goal of reduced threat from wildfire within the cumulative effects analysis area.	Most facilities in moderate to high risk area from potential wildfire damage	Reduction in tree density, fuel loading and ladder fuel that provides defensible space
I	Warm Fire Suppression area (portion)	Fire Use Project converted to suppression 2006	~7,900	**7,900 acres** under Warm Fire suppression below the 8,500 foot elevation mark. Increased acres of aspen, grass, forbs and shrubs.	Existing Condition Early seral vegetation in place along with many standing dead burned trees (snags) and limited dozer lines.	Uneven-aged stand structure. Some in ponderosa pine but most in mixed conifer
J	Warm Fire Recovery Project (portion)	Salvage timber below the 8,500 foot elevation.	~160	Salvage burned timber and replant trees. Increased acres of aspen, grass, forbs and shrubs, snags, downed logs and DWC. When additive to the JR project, essentially **160 additional acres** of VSS 1 are added to 6% of VSS 1 in the ad-hoc area.	Early seral plants in place along with many standing dead burned trees (snags). Small recovery plot below 8,500 foot elevation.	Uneven-aged fire adapted ponderosa pine stands.
K	Moquitch (portion inside Ad-hoc area)	Wildlife Habitat Improvement Project 2011-2013	~9,424	Thinning of small diameter trees that are < 12.0" DBH **on 500 acres**; plus prescribed burning on approximately **9,500 acres**, to improve vegetative structure for wildlife habitat. Treat up to **5,000 acres** a year.	Ponderosa Pine densities of up to 830 trees/acre. **500 acres** of small-diameter even-aged ponderosa pine (an undesirable condition).	Reduction in tree density to 200 trees per acre; uneven-aged fire adapted ponderosa pine stands.
L	Cancoop (portion within Ad-hoc area)	Wildlife Habitat Improvement Project 2011-2013	~ 816	Prescribed burning on approximately **6230 acres** to improve timber stand and vegetative structure for wildlife habitat. (current vegetation allotment within the Ad-hoc analysis area = **467 acres** of pine, **347 acres** of Pinion & Juniper, and **2 acres** of grass)	Sloped areas - within ponderosa pine / pinion and juniper transition zone.	Uneven-aged stand structure for ponderosa pine. Reduction in fuel loading and increases in grass, forbs and shrubs.

Cumulative Actions Table						
Actions Outside the Ad-Hoc Analysis Area for Jacob-Ryan						
Item	**Project Name**	**Project Type & Date/Year**	**Acres**	**Project Description/Effects**	**Current Condition**	**Desired Condition**
M	Warm Fire Suppression	Fire Use Project converted to suppression 2006	~31,100	**31,100 acres** under Warm Fire suppression. Regeneration to aspen and shrubs; fire resistant area.	Early seral vegetation in place along with many standing dead burned trees (snags) and limited dozer lines.	Uneven-aged stand structure. Some in ponderosa pine but most in mixed conifer
N	Warm Fire Recovery Project	Salvage timber 2010	~8,840	Salvage burned timber and replant trees. Specific effects by resource Reforestation benefit on **2,500 acres** to date.	Early seral plants in place along with many standing dead burned trees (snags).	Uneven-aged, fire adapted mixed conifer stands
O	Forest Service Road Hazard Tree Removal	Hazard tree removal along FS roads in the Warm Fire Suppression Area 2009	~1,900	Hazard tree removal along Forest Service roads and trails for public safety following the Warm Fire Use Area burn. Constitutes only about 3% of project in the fire use area and-97% is in the suppression area. Ongoing; regeneration to aspen and reforestation with ponderosa pine and Douglas-fir.	Ongoing about one-half completed with removal of dead burned trees leaving remaining green trees.	Removal of standing dead trees along FS roads
P	Moquitch (portion outside Ad-hoc area)	Wildlife Habitat Improvement Project	~576	Overall project acreage ~ **10,000 acres**. (**576 acres** within the Warm Fire Suppression Area above 8500 feet in elevation). Thinning of small diameter tree < 12.0" DBH on **500 acres**, and prescribed burning on approximately **9,500 acres**, to improve vegetative structure for wildlife habitat. Treat up to **5,000 acres** a year.	Ponderosa pine densities of up to 830 trees/acre. Project area includes **500 acres** of small-diameter (< 12-inches DBH) of even-aged ponderosa pine.	Reduction in tree density to 200 trees per acre; uneven-aged fire adapted ponderosa pine stands.
Q	Cancoop (portion outside Ad-hoc area)	Wildlife Habitat Improvement Project 2011-2013	~ 5414	Prescribed burning on approximately **6230 acres** to improve timber stand and improvement to vegetative structure for wildlife habitat.	Sloped areas - within ponderosa pine / pinion and juniper transition zone.	Uneven-aged stand structure for ponderosa pine. Reduction in fuel loading and increases in grass, forbs and shrubs.
R	Plateau Facility Fire Protection Project	Facility Fuels Reduction project on Kaibab Plateau 2011/2012	~3488	North Kaibab Plateau facility and urban interface fuels reduction project designed to protect multiple stakeholders, their property and ensure public safety from wildfires A portion of the **5081 acre project** is within JR (833 acres) and the ad-hoc analysis area The project will add beneficially to the goal of reduced threat from wildfire within the cumulative effects analysis area.	Locations include ponderosa pine, and mixed conifer at higher elevations. Most facilities in moderate to high risk area from potential wildfire damage	Reduction in tree density, fuel loading and ladder fuel that provides defensible space

3.2.2 FIRE AND FUELS

The existing and foreseeable arrangement and management of fuel in the Jacob- Ryan project area is very important when addressing the risk of wildfire in the area. Currently, the Jacob Ryan area surface fuel loadings within the project area have been estimated by ocular reconnaissance using the photo series for the Southwestern Region (USDA, 1996) and range from 3 to 30 tons per acre. According to the Forest Plan the desired surface fuel loadings for this area should range from 5 to 7 tons per acre. Based on the existing conditions, the project area is prone to high intensity stand replacement fire behavior that could have long term impacts to the ecosystem. For example, high intensity fire behavior associated with passive or active crown fires can lead to stand replacement fire events that are not typically associated with the historical fire regime of Southwestern ponderosa pine forests. These high intensity fire behavior patterns can cause long range spotting and compromise firefighter and public safety, reduce soil productivity and remove valuable nutrients in the soil that promote stand regeneration post a wildfire event. Currently the canopy fuels are overly abundant and continuous this has been determined by examining current stand exam data and through personal observation. The current stand exam data for the Jacob Ryan project area demonstrates that the existing Canopy Base Heights (CBH), Canopy Bulk Density (CBD), Torching Index (TI), and Crowning Index (CI) values are in a condition that would allow an increased potential for passive and active crown fires that would result in high intensity fire behavior patterns that would demonstrate spotting, and rapid rates of spread that would reduce containment efforts and impact firefighter and public safety. The area has little sunlight penetration to the forest floor which has reduced the herbaceous cover under the canopy of trees. Desired conditions indicate a need for increased cover, diversity and production of herbaceous species in the understory; primarily in the form of grasses. These herbaceous plants are important to soil productivity, wildlife and the maintenance of fire as an important and natural ecosystem disturbance. Desired conditions for surface and canopy fuels would allow fire to function as a natural disturbance within the Jacob Ryan ecosystem without causing loss to ecosystem function or to human safety, lives and values. Fire behavior conditions that would occur under the desired conditions and that would mimic a natural disturbance would range from creeping surface fires with flame lengths less than one foot burning in conifer litter and duff; to active surface fire burning freely in all surface fuels, and actively torching groups of seedling and sapling sized (1-6 inch DBH) trees. The more active fires may also occasionally torch out individual overstory trees of various sizes as well as small groups of overstory trees with continuous ladder fuels beneath them. These desired forest conditions would provide for diversity within stands without sustaining crown fire. These conditions would allow managers to use wildfire and prescribed fire to maintain fuel accumulations within the desirable range, assist in maintaining desirable stand structure, an otherwise perform its role as a natural disturbance factor within the ecosystem.

Fire behavior is the manner in which a fire reacts to available fuels, weather, and topography. A change in any of these components results in a change in fire behavior (DeBano et al 1998). Fire behavior is complex, with many contributing factors in the categories of topography (slope, aspect, elevation), weather (climate, air temperature, wind, relative humidity, atmospheric stability) and fuels (size, type, moisture content, total loading, arrangement) (Agee 1993). These three components comprise the fire environment, surrounding conditions, influences, and modifying forces determine fire behavior (NWCG 2004). Topography and weather at a given location cannot be controlled by management, therefore, fuel, comprised of live and dead vegetative material is the only controllable factor.

Fuel management modifies fire behavior, ameliorates fire effects, and reduces fire suppression costs and danger (DeBano et al 1998). Manipulating fuels reduces fire intensity and severity, allowing firefighters and land managers more control of wildland fires (Pollet and Omi 2002). Fuel management can include reducing the loading of available fuels, lowering fuel flammability, or isolating and breaking up large continuous bodies of fuels (DeBano et al 1998).

The risk of stand replacing crown fire can be measured by looking at average canopy bulk density and Canopy base height (CBH) across a stand. Canopy bulk density (CBD) is defined as the mass of available canopy fuel per unit volume (Scott and Reinhardt 2001). For any given tree species, a stand with widely spaced trees has a lower CBD value which makes it more difficult for the stand to sustain a crown fire. Tightly spaced trees with interlocking crowns will have higher CBD and therefore will have more potential to sustain and propagate a stand replacing fire. CBH is the lowest height above the ground at which there sufficient amount of canopy fuel to propagate fire vertically into the canopy (Scott and Reinhardt 2001). The lower the canopy base height the easier it is for a given surface fire to initiate a crown fire (Van Wagner 1977). Canopy base height coupled with canopy bulk density allow managers to understand how likely a crown fire is to initiate and sustain itself across a stand. Additionally, managers evaluate Torching Index (TI) and Crowning Index (CI) to understand how likely a crown fire is to initiate and sustain itself across a stand. Torching Index (TI) is the 20-foot wind speed (in miles per hour) at which a surface fire is expected to ignite the crown layer. Torching index depends on surface fuels, surface fuel moisture, canopy base height, slope steepness, and wind reduction by the canopy. As surface fire intensity increases (with increasing fuel loads, drier fuels, or steeper slopes) or canopy base height decreases, it takes less wind to cause a surface fire to become a crown fire (Scott and Reinhardt 2001). Crowning index (CI) is the 20-foot wind speed (in miles per hour) at which crown fire is possible. Crowning index depends on canopy bulk density, slope steepness, and surface fuel moisture content. As a stand becomes denser, active crowning occurs at lower wind speeds and the stand is more vulnerable to crown fire. Lower index numbers indicate that crown fire can be expected to occur at lower wind speeds, so crown fire hazard is greater at lower index values (Scott and Reinhardt 2001).

- **EFFECTS ANALYSIS**

In order to evaluate the effects of the No Action Alternative against the two Action Alternatives; Crown Fire Potential was analyzed using FlamMap (Finney 2003, Finney 2006). Canopy bulk density, canopy base height, crowning index, and torching index was determined using the Fire and Fuels Extension, FFE (Reinhardt and Crookston 2003) to the Forest Vegetation Simulator, FVS (Dixon 2002). Data used in FlamMap and FVS-FFE were from field sampled stand exams conducted in the Jacob Ryan project area. Results from the Fire and Fuels Extension were used to determine if CBD, CBH, Torching Index (TI), and Crowning Index (CI) values improved when compared to the values listed under the No Action Alternative. Additionally, the outputs from FFE demonstrate the effect of canopy openings and distribution of tree groups and clumps have on the potential for surface, passive or active crown fires throughout the project area. The output values for CBD, CBH, CI and TI are the key outputs that managers utilize to determine the potential for surface, passive, or active crown fires throughout the project area.

The FVS model used to simulate treatment in this analysis utilized 2 year time frame increments post completion of the mechanical treatments in year 0 for modeling purposes and 20 year periods thereafter. This is an artifact of the modeling process; it is important to look at the effects on fuels and fire behavior over longer periods of time when compared to the effects of mechanical treatments. A simulated "cool-end" prescribed fire was simulated 2 years post mechanical treatment, which will be displayed as Fuels Year 0, for analysis purposes; post mechanical treatments across the Jacob Ryan project area to reflect the associated prescribed fire treatments post mechanical thinning operations. The "cool-end" prescribed fire was simulated to reflect that 70% of the stand burned under this treatment. High fuel moistures were utilized because FFE overestimates fire effects. Therefore, when comparing the effects of the Alternatives year 20 is the simulated year that was utilized to analyze the effects of the prescribed fire treatment post mechanical treatments. It is also important to note that no further treatment occurs between year 20 and year 40, that timeline is listed to reflect how well the alternatives are maintaining resiliency against the potential for passive and active crown fires.

- **Direct and Indirect Effects- Modified Proposed Action Alternative**

The Modified Proposed Action alternative would include the use of mechanical treatments and prescribed burning to move the project area timber stands toward the desired structural condition for implementing northern goshawk standards and guidelines as recommended in the Forest Plan. This involves following both the northern goshawk and visual quality guidelines. For this project and entry, the NKRD has proposed implementation of the northern goshawk standards and guidelines of the Kaibab Forest Plan (Forest Plan, pp. 38 – 48). Mechanical treatments would be complimented with prescribed fire. To prevent soil impacts from broadcast burning in areas with 15 tons or more fuel loading per acre, the slash would be piled, and the piles burned, prior to prescribed burning. Prescribed burns would aim to reduce surface fuel loads to the desired 5 to 7 tons per acre. Mechanical and prescribed fire treatments would focus on creating surface fuel loads and stand structure that promote surface fire behavior and are more resistant to passive and active crown fires.

The Modified Proposed Action Alternative shows a marked reduction in passive crown fire potential, which would indicate much less resistance to control and less spotting potential. As seen in the Table 14 below, the Year 20 column reflects the amount of surface, passive crown or active crown fire potential can be expected in Year 20 post treatment (mechanical and prescribed fire). Outputs for the Modified Proposed Action alternative demonstrate that 88% percent of the project area would have the potential to burn as surface fire, 12% of the project area would have the potential to burn as passive crown fire and 0% of the project area would be susceptible to active crown fire.

Table 14: Percent of the Jacob Ryan project area demonstrating potential for different types of fire by the Alternative.

Comparison of Potential for Different Types of Fire	Modified Proposed Action (Alternative 1)			No Action (Alternative 2)			16-inch Diameter Cap (Alternative 3)		
Fuels Year	**0**	**20**	**40**	**0**	**20**	**40**	**0**	**20**	**40**
Surface Fire	51%	**88%**	93%	47%	**62%**	70%	48%	**87%**	90%
Passive Crown Fire	48%	**12%**	7%	51%	**34%**	28%	52%	**13%**	10%
Active Crown Fire	1%	**0%**	0%	2%	**4%**	2%	1%	**0%**	0%

Figure B-1 (Appendix B) demonstrates the outputs listed in Table 14 (above) in a landscape level depiction and represents fire potential across the Jacob Ryan project area post mechanical and prescribed fire treatment in Year 20.

All results from FFE are stand averages and therefore can give a general idea of what stand conditions look like but cannot address the spatial distribution of specific metrics in terms of how individual trees are arranged within a specific stand. The output values for CBD, CBH, CI and TI are the key outputs that managers utilize to determine the potential for surface, passive, or active crown fires throughout the project area. The existing stand conditions and the FFE outputs based on the current conditions

demonstrate that the current output values are in a condition that would allow an increased potential for passive and active crown fires that would result in high intensity fire behavior patterns that would demonstrate spotting, and rapid rates of spread that would reduce containment efforts and impact firefighter and public safety. The desired conditions are for stand averages and therefore allow for some areas within a stand to be outside of the desired condition range but be surrounded with conditions closer to the overall desired conditions. Fire behavior conditions that would occur under the desired conditions would range from creeping surface fires with flame lengths less than one foot burning in conifer litter and duff; to active surface fire burning freely in all surface fuels, and actively torching groups of seedling and sapling sized (1-6 inch DBH) trees. The more active fires may also occasionally torch out individual overstory trees of various sizes as well as small groups of overstory trees with continuous ladder fuels beneath them. These desired forest conditions would provide for diversity within stands without sustaining crown fire. For example Crown Bulk Density is desirable to be below 0.05 kg/m3 as an average over a ponderosa pine stand. This could mean that many patches within the stand have much higher CBD but have interspaces between these dense clumps of trees where CBD is much lower than 0.05 and therefore the average for the stand is within acceptable limits. Where CBD is high it is important to have higher CBH. As seen in the table 15 (below) the Modified Proposed Action Alternative improves CBH, CBD, CI, and TI when compared to the existing conditions and the Year 20 outputs for the No Action Alternative.

Table 15. Fire and Fuels Extension to the Forest Vegetation Simulator results No Action vs. Modified Proposed Action.

Strata	Measurement	Existing Condition	Modified Proposed Action (Alternative 1)				No Action Alternative (Alternative 2)				16-inch Diameter Cap (Alternative3)			
			Yr. 0	Yr. 20	Yr. 30	Yr. 40	Yr. 0	Yr. 20	Yr. 30	Yr. 40	Yr. 0	Yr. 20	Yr. 30	Yr. 40
NEST	CBH	**8**	9	**16**	17	18	9	**9**	11	12	9	**16**	17	18
	CBD	**0.056**	0.06	**0.046**	0.048	0.049	0.061	**0.062**	0.062	0.061	0.06	**0.046**	0.048	0.049
	CI	**37**	38	**43**	42	41	37	**36**	36	36	38	**43**	42	41
	TI	**28**	35	**79**	86	88	32	**32**	40	50	35	**79**	86	88
FA Uneven	CBH	**8**	10	**16**	16	18	8	**11**	12	13	9	**14**	16	17
	CBD	**0.045**	0.047	**0.041**	0.044	0.045	0.055	**0.056**	0.057	0.057	0.055	**0.045**	0.048	0.05
	CI	**38**	45	**49**	47	46	41	**40**	39	39	42	**47**	44	44
	TI	**29**	42	**76**	77	82	35	**41**	46	54	38	**68**	70	73
FA/PFA Even	CBH	**6**	8	**13**	15	17	7	**10**	12	13	8	**12**	14	16
	CBD	**0.044**	0.047	**0.038**	0.041	0.043	0.055	**0.06**	0.063	0.064	0.053	**0.042**	0.047	0.049
	CI	**48**	46	**52**	48	47	42	**38**	36	36	43	**50**	45	43
	TI	**20**	34	**54**	74	87	30	**45**	55	65	32	**50**	66	80
PFA Uneven	CBH	**9**	10	**16**	17	18	11	**12**	13	15	10	**15**	16	18
	CBD	**0.052**	0.053	**0.044**	0.046	0.05	0.057	**0.058**	0.059	0.059	0.056	**0.046**	0.048	0.05
	CI	**39**	41	**45**	44	42	38	**37**	37	36	39	**45**	43	42
	TI	**35**	41	**79**	88	81	41	**47**	55	61	43	**73**	80	81

As seen in the Table 15 (above) the Modified Proposed Action alternative improves CBH, CBD, CI, and TI when compared to the No Action alternative. In the Year 20 column in the table above, CBH has increased and CBD values have decreased and are lower than the existing condition values and the output values listed in the Year 20 column for the No Action Alternative. These stands have less potential to exhibit passive and active crown fire behavior. Crowning Index and Torching Index values have improved as well under the Modified Proposed Action Alternative. Under the Modified Proposed Action alternative these stands are less likely to exhibit torching (passive crown fire) and less likely to produce lofted embers that start more fires, and these fires generally burn cooler and slower and typically burn in the surface fuels. Fire behavior conditions that would occur under these conditions would range from creeping surface fires with flame lengths less than one foot burning in conifer litter and duff; to active surface fire burning freely in all surface fuels, and actively torching groups of seedling and sapling sized (1-6 inch DBH) trees. The more active fires may also occasionally torch out individual overstory trees of various sizes as well as small groups of overstory trees with continuous ladder fuels beneath them. These desired forest conditions would provide for diversity within stands without sustaining crown fire. These types of fire are less likely to cause high fire severity effects, less ecosystem damage, and move the forest towards desired conditions. By moving towards these desired conditions for surface and canopy fuels; fire would be allowed to function as a natural disturbance within the Jacob Ryan ecosystem without causing loss to ecosystem function or to human safety, lives and values. The desired forest conditions would provide for diversity within stands without sustaining crown fire. These conditions would allow managers to use wildfire and prescribed fire to maintain fuel accumulations within the desirable range, assist in maintaining desirable stand structure, an otherwise perform its role as a natural disturbance factor within the ecosystem.

- **Direct/Indirect Effects- No Action Alternative**

Current and existing management plans would continue to guide the project area. No mechanical treatment or prescribed burning is being proposed under this alternative. Wildfire would continue to be managed with protection and/or resource benefit objectives as appropriate.

Effects of the No Action Alternative will allow the ecosystem to move toward more and more unsustainable characteristics. Canopies will continue to close and provide more and more continuous fuel across the landscape. This can be concluded from comparing the amount of passive and active crown fire potential (Year 20) in comparing the No Action Alternative to both Action Alternatives. The No Action Alternative would maintain 38 percent of the area with potential for high severity fire effects (passive and active crown fire potential), while the Action Alternatives 1 and 3 reduce this potential to 12% and 13% respectively. This canopy fuel accumulation has negative effects on understory vegetation and will continue to suppress the production of forbs, grasses, and shrubs. Over time it can be expected that most of the forest will have little to no understory due to sunlight not penetrating the canopy. The combination of abundant and continuous canopy fuels, the lack of understory vegetation and high fire severity fire potential remains in the project area for the foreseeable future. The No Action Alternative shows a continued potential for passive and active crown fire potential, which would indicate more resistance to control and spotting potential. Table 14 (above) reflects the FlamMap outputs under the No Action Alternative.

It is important to note the percentages for passive crown fire continues to decline in Year 40, while the percentage for surface fire increases in Year 40, and the percentage for active crown fire potential remains constant in Year 40. This is based on the fact that trees continue to grow under this simulation and their crowns increase in height as they grow. Nature is dynamic; as the crowns increase in height the trees become less susceptible to passive or active crown fire potential. However, under the no action alternative seedlings and saplings will continue to develop in the understory and ladder fuels will facilitate a greater potential for passive and active crown fires within the project area.

Figure B-2 (Appendix B) demonstrates the outputs listed in table 14 in a landscape level depiction and represents fire potential across the Jacob Ryan project area under the no action alternative (existing conditions moving forward through time).

- **Direct and Indirect Effects- 16- Inch Diameter Cap Action Alternative**

The only difference between this Action Alternative and the Modified Proposed Action Alternative is that a 16-inch Diameter Cap is applied to the mechanical thinning operations in this Alternative versus an implementation strategy that adheres to the northern goshawk standards and guidelines in the Modified Proposed Action Alternative. The 16-Inch Action Alternative incorporates all of the same mitigations and best management practices as the Modified Proposed Action except tree cutting would be limited to stems less than 16 inches in diameter.

The 16- Inch Action Alternative shows a marked reduction in passive crown fire potential, which would indicate much less resistance to control and less spotting potential. As seen in the table below, the Year 20 column reflects the amount of surface, passive crown or active crown fire potential can be expected in Year 20 post treatment (mechanical and prescribed fire). Outputs for the 16- Inch Action alternative demonstrate that 87% percent of the project area would have the potential to burn as surface fire, 13% of the project area would have the potential to burn as passive crown fire and 0% of the project area would be susceptible to active crown fire.

Figure B-3 (Appendix B) demonstrates the outputs listed in Table 14 (above) in a landscape level depiction and represents fire potential across the Jacob Ryan project area post mechanical and prescribed fire treatment in Year 20.

All results from FFE are stand averages and therefore can give a general idea of what stand conditions look like but cannot address the spatial distribution of specific metrics in terms of how individual trees are arranged within a specific stand. The output values for CBD, CBH, CI and TI are the key outputs that managers utilize to determine the potential for surface, passive, or active crown fires throughout the project area. The existing stand conditions and the FFE outputs based on the current conditions demonstrate that the current output values are in a condition that would allow an increased potential for passive and active crown fires that would result in high intensity fire behavior patterns that would demonstrate spotting, and rapid rates of spread that would reduce containment efforts and impact firefighter and public safety. The desired conditions are for stand averages and therefore allow for some areas within a stand to be outside of the desired condition range but be surrounded with conditions closer to the overall desired conditions. For example Crown Bulk Density is desirable to be below 0.05 kg/m3 as an average over a ponderosa pine stand. This could mean that many patches within the stand have much higher CBD but have interspaces between these dense clumps of trees where CBD is much lower than 0.05 and therefore the average for the stand is within acceptable limits. Where CBD is high it is important to have higher CBH. As seen in the table below, the 16- Inch Diameter Cap Action Alternative improves Canopy Base Height (CBH), Canopy Bulk Density (CBD), Crowing Index (CI), and Torching Index (TI) when compared to the existing conditions and the Year 20 outputs for the No Action Alternative.

As seen in the Table 15 above, the 16- Inch Diameter Cap Action alternative improves CBH, CBD, CI, and TI when compared to the No Action alternative. In the Year 20 column in the table above, canopy base height (CBH) has increased and canopy bulk density (CBD) values have decreased and are lower than the existing condition values and the output values listed in the Year 20 column for the No Action Alternative. These stands have less potential to exhibit passive and active crown fire behavior. Crowning

Index (CI) and Torching Index (TI) values have improved as well under the 16- Inch Diameter Cap Action Alternative.

The major difference in this action alternative versus alternative one (the other action alternative) is the ability to cut any size tree versus being limited to only cutting trees less than 16 inches in diameter. Several factors are important to consider when looking at management of the Jacob Ryan area with and without diameter cutting limits. Important ecosystem components in the effect analysis for Jacob Ryan include canopy openings, understory vegetation, and fire behavior. In general canopy openings have been greatly reduced during the 1900's by post settlement trees (Moore and Huffman 2004). Canopy openings provide for wildlife habitat, understory diversity (Kerns et al. 2003, Moore et al. 1999) and discontinuous canopy fuels, which in turn affect fire behavior. All three of these ecosystem components are interconnected. The ability to create canopy opening becomes very important to restoring the function and resiliency of the ecosystem.

Having a 16-inch diameter cap limits capabilities to create these gaps. In this case the retention of 16 inch diameter trees would increase the potential for passive crown fire and decrease the ability to restore the landscape to a more natural fire regime. This will in turn effect how the area can be managed when faced with naturally occurring wildfires. Fires that exhibit torching (passive crown fire) are more likely to produce lofted embers to start more fires, and generally burn hotter and faster than a fire burning only surface fuels. These types of fire will cause higher severity, more ecosystem damage, and move the forest further from desired conditions.

- **CUMULATIVE EFFECTS**

Vegetation treatments, past timber sale activity, and large wildfires on the Kaibab Plateau have contributed to the current condition and will contribute to shape the future stand conditions for the area. The cumulative effects area considered for this analysis is the JR Ad-hoc area. Over the past 20 years management surrounding the Jacob Ryan area has included prescribed burning, pile burning, mechanical thinning and various harvests as well as grazing and wildlife focused projects. Twenty years will be the temporal boundary considered for this analysis, as it is considered that activities beyond that time period are no longer contributing to effects within the analysis area. Within the Ad-hoc boundary there are several projects that are adjacent or are in close proximity to the Jacob Ryan project area. In 2006, the Warm Wildland Fire Use fire treated approximately 19,000 acres of vegetation near the Jacob Ryan project area. The Warm Fire Use reduced fuel loading and has provided an increase in grasses, forbs, and shrubs. These 19,000 acres of improved fuel hazard conditions, in combination with the 25,297 acres of improved conditions resulting from JR, makes a cumulative benefit of 44,297 acres.

Additionally, 7,900 acres of the Warm Fire Suppression area (below the 8,500 foot elevation marker) burned within the Jacob Ryan Ad-Hoc Analysis area. Most vegetation in this area is in early seral stages and there are many standing dead burned trees (snags) and limited dozer lines are still visible. From a fuels hazard perspective, hazard will remain low for at least the 20 year time period of this analysis and will not add cumulatively to activities proposed by the JR project.

The Plateau Facilities Fire Protection project (PFFPP) will treat approximately **5,080 acres** of forested land within the cumulative effects analysis area, approximately **771 acres** of this project are (Wildland Urban Interface) within the Jacob Ryan project area. The PFFPP project will reduce the threat of high intensity wildfires by thinning understory trees, pile burning, and broadcast burning to improve life safety and increase defensible space around multiple facilities across the NKRD and within the Jacob Lake area. This project provides cumulatively additive beneficial effects when combined with the proposed actions of JR for reduced fuel hazard.

The District is also continuing work on the Fracas Wildlife Project; approximately **2,000 acres**, to the south/southwest of the Jacob Ryan project area. This project includes mechanical thinning followed by prescribed burning in phases over several years to increase wildlife habitat, reduce surface fuel conditions, and improve overall forest health. During 2010, **1,264 acres** were treated with prescribed fire in the Fracas Wildlife project area with success and the area is moving towards a fire adapted uneven-aged stand structure. This project also adds to JR, as a beneficial effect, for reduced fuel hazard.

The combined effect of these ongoing projects and many foreseeable projects on the Kaibab Plateau will provide for restoration and fuel reduction and will provide for a mosaic of stand conditions, allowing for wildlife habitat and vegetative diversity. This same mosaic would allow for a diversity of fire effects thereby increasing opportunities for the maintenance of forest structure and function using natural and prescribed fire in the long term future. Both action alternatives proposed in the Jacob Ryan area would continue to create a mosaic of fuel along the Kaibab Plateau. Under the no action alternative the Jacob Ryan area will continue to be considered a high fire risk area along the Kaibab Plateau with high potential for severe fire effects. The proposed actions in the Jacob Ryan area will provide for fewer negative effects from aggressive fire suppression activities and severe fire behavior. For a complete list of past and foreseeable projects adjacent to the Jacob Ryan project area see Figure 11 and Table 13 above.

- **EVEN-AGED STANDS**

Stand-level summary statistics were used to stratify the project area into categories based on the type of stand. The Even-aged stratum covers approximately 6,293 acres, and VSS as a whole-stand was assigned to each site (Common Stand Exam summaries). Since the shelterwood units with residual trees left over after treatment would not be designated for final removal, the VSS classifications were based on the regenerated forest in those areas (see Table 2 above). This basically means that overstory was not used to classify VSS in two-storied stands.

Dominance and basal area, as related to the determination of VSS, is described in the Vegetation Resource Specialist Report (2010 PR-29).

3.2.3 SOILS AND WATERSHED

- **DIRECT AND INDIRECT EFFECTS OF ACTION ALTERNATIVES**
  - Alternative 1 – Modified Proposed Action (no mechanical activity in TES Map Unit 9)
    &
  - Alternative 3 – 16-inch Diameter Cap Cutting Limit (this action excluded the cutting of trees 16 inches or greater in diameter.)

Some adverse effects to soil condition are common to the timber harvesting under action Alternatives 1 and 3, but vary slightly between the two by the amount of volume harvested. Alternative 1 harvests the greatest amount of volume, while Alternative 3 harvests the least amount of volume since trees over 16 inches in diameter and larger are excluded. However, the total acres treated are the same under each action alternative.

Under the action alternatives, timber harvest activities are to be conducted using mechanized equipment, except on TES Map Unit 9. Activities such as whole tree skidding, decking, road maintenance, machine and hand piling of slash will result in various degrees of soil displacement, soil compaction, on-site soil loss and disturbance to vegetative ground cover within cutting units. Skid trails, landings, and haul roads will result in some loss of vegetative ground cover and increased bare soil. Some increases in on-site soil loss, runoff and sedimentation will occur. Several site specific and general Best Management Practices (PR-27 & Appendix C-2) have been developed to reduce erosion, runoff and sedimentation. Effects to

various soil conditions from proposed actions are in Table 16, summarized below and further described in the Soils and Watershed Resource Report (2011 PR-64).

Table 16. Relative Effect by Action Alternative (Soils & Water Quality)

Resource & Unit of Measure	ALTERNATIVES		
	1 Modified Proposed Action	2 No Action	3 Diameter Limit of 16 in. DBH
--- SOILS AND WATER QUALITY ---			
Soil disturbance / displacement	**2,000-3,000 acres** are expected to exhibit some level of soil disturbance in the form of topsoil displacement and minor profile redistributions from mechanical equipment used to fell, bunch and skid logs. These disturbances will be of short duration as sites will stabilize and revegetate within 1 to 5 years. Adverse disturbance will be minimized by implementation of BMPs. This Alternative would achieve desired condition for soils and watershed by removing adequate canopy cover to allow sunlight to penetrate to the forest floor, increasing the growth response of grasses, forbs and shrubs. Fine roots and vegetative ground cover provided by grasses and forbs can more effective protect soils from erosion by wind and water than forest litter alone.	No new soil disturbance or displacement would occur	While the types of disturbance will be the same as Alternative 1, slightly fewer acres are expected to exhibit soil disturbance since fewer large trees would be removed, reducing the amount of felling, bunching, skidding, decking, and hauling. However, this alternative would not fully achieve the desired condition for soils in the project area since higher residual tree canopy cover would intercept more sunlight than Alternative 1, decreasing light penetration to the forest floor, thus decreasing the response of grasses and forbs which provide maximum protection of soil surfaces from wind and water erosion. The same numbers and lengths of skid trails, and temporary roads are expected under Alternative 3 as under Alternative 1.
Soil erosion	Erosion potential is expected to increase on 10 to 15 percent of areas treated mechanically due to removal or displacement of ground cover. This erosion would be short term (1 to 5 years), localized, and mitigated with implementation of appropriate BMPs. Erosion potential on TES map unit 9 would be reduced due to introduction of CWD on soil surfaces in this map unit.	No soil erosion above current levels would occur.	Erosion potential is expected to increase approximately the same amount as Alternative 1 on areas treated mechanically since the same number and lengths of skid trails and roads and number of landings are expected to occur. Since fewer trees would be removed, traffic on these areas would be reduced slightly. Erosion would be short term (1 to 5 years), localized, and mitigated with implementation of appropriate BMPs. Erosion potential on TES map unit 9 would be reduced due to introduction of CWD on soil surfaces in this map unit.
Soil compaction	Approximately **2,000-3,000 acres** are estimated to exhibit varying degrees of soil compaction, depending on the number and locations of skid trails, landings, and roads, timing of activities, and types of machinery and manual treatments employed. Some dispersed soil compaction would likely occur in areas where trees are mechanically felled and bunched prior to skidding.	No additional areas of soil compaction would occur	Slightly fewer acres are expected to exhibit soil compaction since fewer large trees would be felled, bunched, skidded to landings, and hauled. However, the number of skid trails and landings would be approximately the same as Alternative 1.
Soil Nutrient Cycling	Soil nutrient cycling would progress toward desired conditions as duff layers are reduced, CWD is increased, and the understory of grasses, forbs, and shrubs improves. Fine roots of grasses and forbs would improve soil aggregate stability, water infiltration, and decrease soil bulk densities.	No changes to nutrient cycling would occur.	Soil nutrient cycling would progress toward the desired condition, but not to the extent provided by Alternative 1. Less light would penetrate the forest canopy and reach the forest floor, resulting in a sparser understory vegetative community. Duff would continue to protect soil surfaces, but not to the extent that grasses, forbs, and associated litter would provide.

Resource & Unit of Measure	ALTERNATIVES		
	1 Modified Proposed Action	2 No Action	3 Diameter Limit of 16 in. DBH
--- SOILS AND WATER QUALITY ---			
Plants / Herbaceous ground cover	Herbaceous ground cover would be greater than Alternatives 2 and 3 one to five years following thinning treatments since more open stand structures would occur following thinning.	Herbaceous ground cover would continue to decline as forest canopies continue to close, soil duff layers increase, and fuel loads continue to increase.	Fewer trees would be removed during thinning, resulting in less open stand structure and less light penetration to the forest floor. Herbaceous ground cover would therefore be less than Alternative 1, but greater than Alternative 2.
Soil CWD component	Within Terrestrial Ecosystem map units 9, 293 (in the Marble Canyon Watershed), 620 (in the Kanab Creek Watershed) and 624 (in the Warm Springs Canyon 6th Code Watershed) lopping and scattering of slash and thinning sub-merchantable material without follow-up burning will increase CWD to satisfactory levels. CWD on **1266 acres** will be improved under this alternative On TES map units that currently have excess CWD, piling followed by use of prescribed fire would bring CWD levels to desired conditions of 5 to 7 tons per acre.	TES map units that do not currently have adequate CWD (i.e., 9, 293, 620 and 624) would exhibit a gradual increase in CWD over a long period of time through tree mortality and decadence. However, these TES units would not benefit from the introduction of CWD that would occur rapidly through vegetation treatments proposed under alternatives 1 and 3.	Within Terrestrial Ecosystem map units 9, 293 (in the Marble Canyon Watershed), 620 (in the Kanab Creek Watershed) and 624 (in the Warm Springs Canyon 6th Code Watershed) lopping and scattering of slash and thinning sub-merchantable material without follow-up burning will increase CWD to satisfactory levels. CWD on **1266 acres** will be improved under this alternative On TES map units that have excess CWD, treatments would achieve the same desired conditions with regard to CWD as alternative 1.
Soil heating and water repellency (hydrophobicity)	Areas where pile burning is conducted, and some areas where prescribed burning is conducted would exhibit hydrophobic soil conditions and soil sterilization caused by rapid oxidation of soil minerals and nutrients. The occurrence of these conditions would depend primarily on the timing, duration, type, and intensity of fire use. TES map unit 9 would exhibit no additional hydrophobicity or sterilization since fire would not be used in this map unit. Vegetation treatments would produce more open stand conditions, including canopy gaps and prescribed fire would reduce fuel loads. These treatments would reduce the risk of high-intensity wildfire and associated adverse impacts to soils and watersheds.	There would be no soil heating or soil water repellency (hydrophobicity) under the No Action Alternative. However, conditions would be conducive to increased hazard of high intensity wildfire that would result in large areas of hydrophobic soils.	The effects of this Alternative are similar to those of Alternative 1. However, there would be fewer piles to burn or less scattered activity-related woody debris under this alternative since fewer trees would be harvested. TES map unit 9 would exhibit no additional hydrophobicity or sterilization since fire would not be used in this map unit. With a 16 in. diameter cap requirement, this alternative would limit the ability to create canopy gaps and open stand conditions to the extent offered under alternative 1. While this alternative would reduce the risk of high intensity wildfire and associated adverse impacts to soils and watersheds, it would not be to the extent available under alternative 1.

Resource & Unit of Measure	ALTERNATIVES		
	1 Modified Proposed Action	2 No Action	3 Diameter Limit of 16 in. DBH
--- SOILS AND WATER QUALITY ---			
Soil Organisms	Soil organism populations are expected to decline for short periods (1 to 3 years) in areas of soil disturbance, compaction and where fire is introduced. Soil organism populations are expected to recover more rapidly under this alternative as greater light would penetrate to the forest floor, increasing soil biological activity.	No changes to soil organism populations would be introduced as a result of this project under the No Action Alternative.	Soil organism populations are expected to decline for short periods (1 to 3 years) in areas of soil disturbance, compaction and where fire is introduced. Soil organism populations are expected to recover more slowly under this Alternative than Alternative 1since less light would penetrate to the forest floor to increase soil biological activity.
Water quality	No perennial streams are located within or near the project area. No detectable change in downstream water quality will occur.	There would be no changes to surface water quality as a result of this project under the No Action Alternative.	No perennial streams are located within or near the project area. No detectable change in downstream water quality will occur.
Water yield	Since only a small percentage of each 5th code watershed is being treated, no detectable change in water yield is expected. Within the project area, increased soil moisture and groundwater recharge can be expected as tree canopy and numbers are reduced.	There would be no changes to water yield as a result of this project under the No Action Alternative	Since only a small percentage of each 5th code watershed is being treated, no detectable change in water yield is expected. Within the project area, increased soil moisture and groundwater recharge can be expected as tree canopy and numbers are reduced. This effect will be slightly less than alternative 1 as fewer trees are removed.

✓ **Commercial Thinning**

An important un-resolved issue identified during public scoping led to this modification of the Proposed Action that would designate leave units and show them on Sale Area Maps to delineate Ecological Map Unit 9 areas, which would be excluded from commercial thinning and heavy equipment operations under the Modified Proposed Action. Existing open roads within Ecological Map Unit 9 needed for hauling could continue to be used. However, skid-trails, landings and other roads needed for commercial thinning would not be located within these leave units. Both action alternatives in Ecological Unit 9 still includes pre-commercial thinning, lopping and scattering slash without follow-up burning, and hand piling and burning of thinning slash only in specific locations where fuel loads exceed 10 tons per acre. Description of the action alternatives thus includes incremental design features developed through the analysis process to address the only important un-resolved issue raised in public scoping for this project.

The effects of hand/or mechanized felling (shear) and mechanized skidding of the logs to landings include exposing soil to accelerated erosion by removal of vegetative ground cover. Ground cover will be disturbed through mechanical actions. Mechanical equipment can compact the ground and, in some cases, channel water. Some degree of compaction is estimated to occur over 5% to 20% of the **24,941 acres** (total vegetation treatment acreage is reduced by 356 acres to account for hand treatments only in TES unit 9) that are mechanically treated; however, detrimental compaction is unlikely to occur over much of the area. Detrimental soil compaction can be minimized and cumulative impacts of compaction can be curtailed by the re-use of existing skid trails and transportation networks during fuel

treatments in these managed stands (Mohandas , Stephens 2007). Best management practice monitoring on the Mogollon Rim Ranger District (Jagow, 1994; Fleishman, 1996 and Fleishman, 2005) has shown that ground disturbance (skidded to mineral soil) and compaction may occur on the approximately 10-15% of the thinning area when mechanized skidding and harvesting occur. Using this approach, approximately 2000 to 3000 acres of ground disturbance and compaction is expected to occur on the vegetation removal treatment area. The duration of this effect is likely to persist from 1-5 years as vegetative and litter ground cover establish on disturbed areas. The duration of effects from surface compaction is not well documented but can be relieved through freeze thaw processes. Best management practices including skid trail designation and limitations on wet soil condition operations have been included to minimize soil compaction in the project area. Whole tree harvest has become the most common method of commercial treatment and is the method expected to be used for the JR project. Hand piling and areas proposed for lop and scatter only will have no ground disturbance associated with the activity. Soil Map unit 9 will suffer no additional compaction from proposed treatments in either alternative 1 or 3.

- ✓ **Soil Bearing Strength (Wet Soil Operability)**

TES map unit 9 occurs on nearly level to gently sloping, simple, linear and concave valley plains. As a result, the soil surface, upper soil layers, and subsoil become wet during times of spring snow melt and intense summer rain storms resulting in these having a low bearing strength when wet. These soils become highly susceptible to compaction, rutting, displacement and the formation gullies (Brewer et. al., 1991). Under the modified proposed action, no mechanical equipment will be allowed within Map Unit 9. Hand thinning followed by lopping and scattering activity-related woody debris will occur on Map Unit 9 to improve soil condition on this map unit. CWD will therefore be improved by leaving pre-commercial thinning slash.

TES map units, 293, 294, 297, 298, 620 and 624 have soils containing montmorillonite, a clay mineral that is a common characteristic of the soils within the project area. It is responsible for soils having a low bearing strength when wet (Brewer et. al., 1991). Unsurfaced roads, skid trails, landings and areas subjected to machine piling activities are highly susceptible to rutting, compaction, and soil displacement during wet soil conditions.

A recent study conducted in Northern Arizona in which one of the objectives was to determine the effects of different harvest severity levels and different harvest systems on soil bulk density (interpretation of soil compaction), showed that timber harvest operations conducted under dry soil conditions produced no significant differences in bulk density between undisturbed (control) and harvest severity or harvest systems. Although, intermediate and high soil profile disturbance was greater under whole tree harvest system than 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). Potential effects are greater under Alternative 1 and are the least under Alternative 2.

However, there should be little adverse effects on soils, since timber harvest operations are limited to reasonably dry or frozen soil conditions and skidding operations are controlled through predesignation. These precautionary measures are included as BMPs in both action alternatives.

- ✓ **Soil Erosion**

One of the direct effects on soil condition from the action alternatives will be from activities involving mechanical equipment. Ground cover will be disturbed through mechanical actions. Skid trails will tend to compact the ground and, in some cases, channel water. This is estimated to occur over 10% to 15% of the areas that are mechanically treated. The expected duration of effects is less than 10 years. Additional loss of ground cover will occur through the burning phase of the project. The combination of thinning to open the stands, and burning, will likely result in the promotion of herbaceous vegetation over

ground litter as the major component of ground cover. Stand canopy conditions and fuel loading will be reduced so that the potential effects of intense wildfire are reduced.

Sheet and rill erosion from forested areas within the project area is normally minimal as indicated by soil condition. Vegetation and litter cover is the greatest deterrent in preventing surface sheet and rill erosion.

Soils that are rated as having a moderate or severe erosion hazard indicate that if vegetative ground cover is removed exposing bare soil, the resultant potential soil loss will result in a lowering of site productivity. These soils will require the application of Best Management Practices (BMPs) as outlined in the Best Management Practices and Monitoring Plan for the JR Vegetation Management (PR-27) to maintain or improve vegetative ground cover and reduce soil loss.

There are 13,026 acres of soils in the project area with moderate erosion hazard and 1,122 acres of soils with severe erosion hazard. Soils with severe erosion hazards are generally on steep terrain except for TES unit 624, which occurs on slopes of 15-40 percent. There are only 33 acres of this TES unit within the project area. In accordance with specified BMPs (PR-27), CWD of 8 to 16 tons per acre would be retained on TES map unit 624 to protect soil surfaces from erosion (Table 17).

Table 17. Predicted Soil Erosion Hazard by TEU within the JR Vegetation Management Project area

MAP UNIT	EROSION HAZARD	EROSION RATE TONS/HA/YR				SLOPE (%)	ACRES
		Potential	Tolerance	Current	Natural		
252	Severe	39.1	6.7	23.3	5.3	40-80	94
263	Moderate	5.0	4.5	3.4	1.5	0-15	1
264	Moderate	39.9	6.7	11.9	4.5	14-40	141
271	Severe	127.0	6.7	17.6	5.4	40-80	262
273	Moderate	24.4	6.7	6.7	2.6	15-40	19
294	Moderate	50.2	6.7	4.5	1.1	15-40	11,595
298	Moderate	50.2	6.7	4.5	1.6	15-40	787
299	Severe	91.5	6.7	8.2	5.1	40-80	295
620	Moderate	47.3	6.7	6.6	4.3	15-40	484
621	Severe	30.5	4.5	9.2	4.3	40-80	434
624	Severe	85.0	6.7	4.7	1.9	15-40	33
625	Severe	162.5	6.7	3.6	3.6	40-120	4
Grand Total							14,148

✓ **Pre -Commercial Thinning**

Effects on soil condition from pre-commercial thinning activities are minimal; however, CWD will be improved on map units 9, 293, 620 and 624 through leaving material > 3 inches in diameter to meet soil condition objectives. Thinning activities are conducted using hand tools to thin trees smaller than 9 inches diameter at breast height (DBH). No mechanized equipment is used. Disturbance to the vegetative ground cover is light with minimal displacement of surface litter. No large increases in soil loss or runoff are expected to occur. Number of acres thinned is the same for all action alternatives.

- ✓ **Coarse Woody Debris – CWD**

Soil condition in ecological map unit 293 (in the Marble Canyon Watershed), 620 (in the Kanab Creek Watershed) and 624 in Warm Springs Canyon 6th Code watershed are considered to be impaired due to inadequate amounts of downed coarse woody debris. Inadequate levels of coarse woody debris may reduce or limit many physical, biological and chemical functions within forested ecosystems. Many nutrients, especially sulfur, nitrogen and phosphorus are released as coarse woody debris decays or is burned. This is especially true during the late stages of decay when nutrient concentration levels are high. Woody materials, especially humus and buried residue in the advanced stages of decomposition are excellent sites for the establishment of ectomycorrhizal fungi. Even though this material may make up only a small portion of the soil horizon, it contains the majority of ectomycorrhizae. Ectomycorrhizae assists woody plants with uptake of water and nutrients, and their fruiting bodies play important roles in the food chains of many small rodents and larger predators (Graham et al., 1994). If coarse woody debris is deficient, the ability of ectomycorrhizae to establish is reduced and may inhibit woody plants from taking up water and nutrients. Impaired soil condition indicates that the inherent productive capacity of the soil resource is reduced with respect to the soil's ability to cycle nutrients. Within these map units, lopping and scattering of slash and thinning sub-merchantable material without follow-up burning will be employed to increase CWD to satisfactory levels. CWD on 1266 acres will be improved under alternatives 1 and 3.

- ✓ **Fuel Treatment**

During commercial thinning operations, whole tree skidding will result in the removal of the entire tree to the log landing area. Slash may be lopped and scattered as described above or machine piled and burned on the log landing site. If not mitigated, potential adverse effects may be a reduction in soil productivity due to the removal of large quantities of potential sources of soil organic matter and nutrients from the landscape to a relatively small localized area (log landing site) where slash is concentrated in large piles and then burned (Poff, 1996). To avoid these potential adverse effects to soil productivity, a minimum of 5 to 7 tons of CWD per acre would be retained following all vegetation treatments. Also, post project activities associated with pre-commercial thinning will include lopping and scattering of activity related slash except where fuel loading exceeds 10 tons per acre where hand piling and burning would occur. BMPs specify that CWD on TES map unit 624 will be manage towards a minimum of 8 to 16 tons per acre. The advantage of this treatment is effects of machine piling and burning occurs on log landing sites without impacting soils in silvicultural treatment areas.

Slash generated from pre-commercial thinning activities will be hand piled and then burned when conditions are suitable for burning. Hand piles occupy small areas although there could potentially be a large number of slash piles created depending on the amount of slash generated. Burning of slash piles results in high intensity fire that generates hot soil temperatures. Surface soil temperatures can burn as hot as 700°C and at 250°C below the soil's surface. Heated soils experience changes in pH, soil nitrogen and organic carbon. Densities of arbuscular mycorrhizal propagules are significantly reduced due to high intensity fire created by burning slash piles. Slash pile scars are difficult to revegetate and may remain void of vegetation for long periods of time. Also, undesirable plant species may become established at bare, sterile sites where slash piles were burned (Lowe, 2005). Number of acres planned for hand piling is the same for all action alternatives.

In addition to machine piling and burning of slash at log landing sites and hand piling and burning of slash as a result of pre-commercial thinning, prescribed burns are also planned. Fire effects on soil, water, and watershed resources may range widely due to variability in resource conditions, season, intensity of burning, and timing, and intensity of precipitation before and after burning. Fire may have perceived negative, beneficial, or benign effects, which may persist for short or long periods.

Appropriate timing of pile burning and specifying the size of burn piles are common mitigation measures and will be implemented to avoid adverse impacts to soil surfaces. By conducting pile burning and prescribed burning under cool, moist conditions adverse impacts to soil chemical and biological properties would be minimized.

Fire frequency, in the context of a site's natural fire regime, has a major impact on soil productivity. Frequent, low-intensity fires, on sites where the vegetation has adapted to them, will increase soil productivity over the long term. Soils that are subjected to intense wildfire more frequently than every one hundred years may experience productivity decline (Poff 1990).

Thus alternative 1, and to a lesser extent alternative 3, will effectively reduce the probability of intense wildfire within the treatment areas. Prescribed burning will have the effect of reducing litter accumulations and most likely promoting herbaceous vegetation. Short-term reductions in ground cover will result where litter is totally consumed. Previous experiences on the Forest, and Harrington and Sackett (1993) have shown that this bare soil is covered by litter or vegetation within three years. Total consumption of ground cover will be patchy and will not adversely affect overall ground cover.

Prescribed burns are low intensity fires that release nitrogen and other nutrients. This can benefit the herbaceous vegetation (Lowe, 2005). Prescribed burns that burn "cool" do not entirely consume forest duff, and therefore can reduce fuels without totally removing effective ground cover (Poff, 1996). The use of prescribed fire in the Southwest is an effective approach to reducing forest fuels while minimizing adverse impacts to soils and watersheds. The least amount of damage occurs during cool-burning, low-severity fires. These fires do not heat the soil substantially, and the changes in most soil properties are only minor and are of short duration. (Neary et al. 2005)

However, potential adverse effects from prescribed burns occur when burns get into areas with heavy concentrations of fuels. The excess heat generated from the burn may be destructive to soils, fungi, the seed bank, herbaceous plants and potentially damage or kill existing trees (Lowe, 2005). Effective vegetative ground cover may be totally consumed, exposing bare soil and leading to an increase in soil loss. These effects on soils where erosion hazard is rated either as moderate or severe may result in a loss of soil productivity due to erosion if not mitigated. Mitigation measures that would avoid these adverse effects are included in the soils and watersheds section of the Best Management Practices for the Jacob-Ryan Project.

✓ **Effects on Water Yield, Watershed and Water Quality**

The hydrologic effect of fuel management activities is likely to be relatively small because only a small part of the forest canopy is being removed. It has been generally accepted that at least 20% of the basal area in a forested watershed must be removed in order to obtain a detectable change in stream flow. As watershed size increases, it is increasingly unlikely that forest management will rapidly affect more than 20% of the basal area in a watershed. In forested watersheds, light to moderate prescribed fire has little effect on streamflow. This is largely because only a small percentage of the vegetation is impacted and net changes in infiltration characteristics are minimal. Since low-severity prescribed fires do not cause a high degree of tree mortality or litter combustion, the effects on evapotranspiration and forest floor water storage are generally too small to change watershed-scale water yields. The reduction in forest floor water storage due to prescribed burning of ponderosa pine varies, but even the lower-most litter layer must be modified or removed before the water holding capacity of the forest floor is significantly reduced. Therefore prescribed fire does not pose a threat to increasing watershed-scale runoff unless a large proportion of the watershed burns at high severity (Troendle et al. 2006**).** Streamflow responses to prescribed fire are smaller in magnitude in contrast to the responses to wildfire. It is generally not the purpose of prescribed burning to completely consume extensive areas of litter and other decomposed organic matter on the soil surface and, therefore, the drastic alterations in streamflow discharges that are

common after severe wildfires do not normally occur. Fire has a range of effects on stream peak flows. Low severity, prescribed fires have little or no effect because they do not substantially alter watershed condition.

✓ **Forest Roads**

There are roughly 280 miles of forest system road within the project area. The condition of these roads ranges from well maintained, suitable for passenger vehicle to unmaintained, suitable for high clearance vehicles only. Where harvest activities occur, there will be some short term disturbance of the road surface by grading and smoothing. Longer term benefits will be realized through improvements in road surface drainage on infrequently maintained roads. No new roads will be constructed under Alternatives 1 or 3.

The risk of sediment impacts to downstream water quality and perennial stream channels due to road maintenance is relatively low. The transportation system required to conduct District management activities is in place. Most of those roads are surfaced with materials derived from the local soils and geology. Traffic is light for most of the year with increased use and impacts during the fall fuel wood gathering and hunting seasons. Erosion from the road template is generally minimal as most roads are located on relatively gentle slopes. No new roads are planned to be constructed. Some closed administrative roads are planned to be re-opened for timber harvest activities, and then closed following use. There are some road segments that are located in or near ephemeral drainages and are the most likely locations to impact to downstream water quality and perennial stream channels during runoff events. However, impacts are assumed to be minimal due to the relatively long distances to perennial waters.

It is expected that there would be a localized short-term direct or indirect effect on sediment due to ground-disturbing activities from road maintenance work. The direct or indirect effect is expected to subside and not be measurable within 3 to 5 years. During project implementation, it is expected that road maintenance will improve and road drainage systems are maintained within the project area.

- Alternative 2—No Action

There would be no mechanical vegetation treatments or prescribed burning treatments under the no-action alternative. No restoration efforts would take place and fuels hazard reduction would not occur. Progress toward the desired basal area per acre or stand density indexes would not occur. This alternative would not meet the purpose and need of the project, but does comply with the National Environmental Policy Act as a basis for comparison with other action alternatives.

In the absence of future landscape disturbances such as uncharacteristically intense large scale wildfire, there will be little change in soil condition from current conditions.

a) No logging slash or pre-commercial thinning material will be produced to improve Coarse Woody Debris in Map Units 293, 620 or 624. Increase in Coarse Woody Debris within those soil map units considered to be deficient will only increase slowly as material accumulates through tree mortality etc.
b) This alternative will perpetuate forest conditions that can sustain uncharacteristically intense wildfire over large areas. Fuel conditions and fire hazard within the project area will remain the same or worsen over time. If and when such an event occurs in the area, severe fire effects on hydrologic function could occur.
c) No pre-commercial thinning will occur in meadow/grassland (Map Unit 9). No improvement in condition will occur through removal of encroaching pine, rather, encroachment will continue with the absence of frequent ground fire.
d) No soil disturbance will occur due to harvest and prescribed burning treatments.
e) No road reconstruction and no road maintenance resulting from purchaser operations will occur.

As a result of no action, the high density of trees combined with high fuel loadings below the forest canopy will persist or increase. As stands become denser, a combination of increased woody debris on the forest floor, increased mid-level forest canopies from younger trees filling in openings in the canopy, and a closed overstory canopy create a "fuel ladder" that allows low-intensity ground fires to move up into the forest canopy, or treetops, and become intense crown fires. Wildfire can have major effects on vegetation, ground cover, and soil properties, resulting in reduced infiltration and increased overland flow. It is widely accepted that fire severity is one of the most important factors controlling postfire soil erosion rates as fire severity directly influences soil cover. (Benavides, 2005*)* Intense wildfire can reduce soil surface resistance to erosion resulting in accelerated soil erosion, particularly during periods of heavy summer precipitation on newly exposed soil.

Severe heating from a wildfire may cause changes in soil properties such as the reduction of structure, reduction of porosity, and change of soil color. Burning reduces soil organic matter, and plant and litter cover. In most cases, soil erosion by wind and water is increased. The severity and duration of accelerated erosion depend on slope, soil texture, recovery of plant material, severity and extent of burning, and post fire precipitation timing and intensity. Duration of the effects of fire on soil structure range from 1 year to many decades depending on the severity of the fire and rate of recovery.

- **Cumulative Effects**

For the purpose of this analysis, the cumulative effects boundary for hydrologic resources is described as the watershed divide boundaries as delineated by the Snake Gulch, House Rock Wash, White Sage and Lower Johnson 5th code watersheds. The 5th code watersheds are the next scale of watershed area that encompass the project area, yet do not add so much watershed area that any cumulative effects are diluted. Surface water from the House Rock 5th code watershed potentially drains into the much larger Marble Canyon portion of the Colorado River, while surface water from the Lower Johnson, White Sage and Snake Gulch 5th code watersheds potentially drain into larger Kanab Creek watershed. For this analysis, surface disturbing activities that are older than 20 years are assumed to be contributing negligible or no measurable cumulative effect within the analysis area. All known past, present, and reasonably foreseeable future activities that could contribute to cumulative effects are listed in tables 18, 19 and 21.

Table 18. Past Activities by Watershed

Watershed (4th Code)		Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)		White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)		137,282		179,372		119,065		192,974	
Vegetation Management	**Year**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Little Miss Timber Sale	1987	----	----	----	----	377	0.3	----	----
Wild Willy Salvage Timber Sale	1987	468	0.3	----	----	608	0.5	----	----
Mistletoe Timber Sale	1988	----	----	312	0.2	1,325	1.1	----	----
Wildfever Timber Sale	1988	419	0.3	----	----	1,242	1.0	----	----
Jack Lily Salvage Sale	1992	----	----	354	0.2	----	----	----	----
Warm Spring Timber Sale	1988	----	----	1,257	0.7	----	----	----	----
Big Frac Timber Sale	1992	----	----	1,107	0.6	----	----	----	----
Past Sales	1980's	----	----	720	0.4	----	----	2,096	1.1
Past Sales	1990's	----	----	710	0.4	----	----	4,574	2.4
Hidden Salvage Sale	2002	----	----	----	----	231	0.2	----	----
Willis Blow Down	2004	13	<0.1	----	----	13	<0.1	----	----

Watershed (4th Code)		Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)		White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)		137,282		179,372		119,065		192,974	
Table 18. Past Activities (con't)									
Vegetation Management	**Year**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Buckskin Chaining & Smashing	2008	2,000	1.9	----	----	----	----	----	----
Fracas	2009	675	0.4	----	----	----	----	----	----
Tree Planting	2008	1252	0.7	----	----	----	----	343	0.2
Tree Planting	2009	445	0.2	----	----	----	----	111	0.1
Fracas PCT	2010	----	----	343	0.2	----	----	----	----
Wildfire Use/Broadcast Burns	**Year**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Fracas Rx Burn	2010	----	----	1243	0.7	----	----	----	----
Lost canyon Rx Burn	2010			200	0.1				
Warm Wildfire Use Area	2006	6,809	5.0	6,514	3.6	----	----	12,130	6.3
Buckskin Prescribed Burn	2009	2,000	1.5	----	----	----	----	----	----
Wildfires	**Year**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Willis Fire	1987	1,129	0.8	----	----	1,129	0.9	----	----
Copper fire	*1988*	----	----	----	----	*26*	*<0.1*	----	----
Ridge Fire	1993	82	<0.1	----	----	----	----	----	----
Bridger Knoll Fire	1996	----	----	19,823	11.1	----	----	----	----
Mangum Fire	2000	----	----	290	0.2	----	----	----	----
Hidden Fire	2001	----	----	----	----	464	0.4	----	----
Big Fire	2002	109	<0.1	----	----	----	----	----	----
Plateau Fire	2002	----	----	----	----	6	<0.1	----	----
Apron Fire	2002	----	----	----	----	9	<0.1	----	----
LeFevre Fire	2004	----	----	----	----	223	0.2	----	----
Warm Fire	2006	----	----	20,596	11.5	----	----	18,505	9.6
Slide Fire	2007	----	----	5,105	2.8	----	----	----	----
Castle Fire	2009	----	----	185	0.1	----	----	----	----
Dee Fire	2009	----	----	215	0.1	----	----	----	----
Ridge Fire	2009	----	----	----	----	224	0.1	----	----
Trail Fire	2009	----	----	----	----	----	----	82	<0.1
Burned Area Rehabilitation	**Year**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Warm Fire (Seeding)	2006	----	----	3,289	1.8	----	----	6,745	3.5
Slide Fire (Seeding)	2007-08	----	----	1,750	1.0	----	----	----	----
Wildfire Suppression Rehab.	**Year**	**Miles**		**Miles**		**Miles**		**Miles**	
Warm Fire Fireline Waterbarred	2006	----		15		----		15	
Warm Fire Fireline Seeding	2006	----		15		----		15	
Slide Fire Fireline Waterbarred	2007	----		11		----		----	
Slide Fire Fireline Seeding	2007	----		11		----		----	

Table 19. Current / Ongoing Activities

Watershed (4th Code)	Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)	**White Sage 15010003-02**		**Snake Gulch 15010003-07**		**Lower Johnson 15010003-04**		**House Rock 15010001-01**	
Watershed Acres (5th Code)	**137,282**		**179,372**		**119,065**		**192,974**	
Livestock Grazing Allotments	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Burro	311	0.2	----	----	----	----	14,578	7.6
Central Summer	9,565	7.0	100,195	55.9	408	0.3	46,158	23.9
Central Winter	----	----	50,548	28.2	----	----	----	----
House Rock	----	----	----	----	----	----	18,212	9.4
Kanab Creek	----	----	7,920	4.4	----	----	----	----
Kane	----	----	----	----	----	----	13,533	7.0
None	----	----	----	----	----	----	2,851	1.5
Ryan	11,572	8.4	9,236	5.1	32,634	27.4	5,681	2.9
Willis Canyon	26,734	19.5	---	----	381	0.3	106	<0.1
Vegetation Management	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
ADOT Hazard Tree Removal	----	----	----	----	140	0.1	140	<0.1
Dry Park	----	----	----	----	4,000	3.4	----	----
North Kaibab Hazard Tree Removal	44	<0.1	----	----	----	----	----	----
Ryan One	----	----	----	----	----	----	1,000	0.5
Green Fuelwood	----	----	----	----	273	0.2	----	----
Other Projects								
Roads/Trails	1.08 miles/sq. mile		6.9 miles/sq. mile		.83miles/sq. mile		6.9 miles/sq. mile	
Dispersed Recreation Activities	Yes		Yes		Yes		Yes	

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Table 20. Proposed Activities

Watershed (4th Code)	Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)	White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)	137,282		179,372		119,065		192,974	
Vegetation Management	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Jacob-Ryan	7,242	5.3	3,661	2.0	12,093	10.2	1,585	.8
Plateau Facilities Protection Project	246	0.2	2,684	1.5	42	0.32	----	----
Burnt Corral Commercial, PCT, Rx	----	----	781	0.4	----	----	----	----
Warm Fire Recovery 20"+/ fuel wood	----	----	2,389	1.3	----	----	1,915	1.0
Warm Salvage 1	----	----	----	----	----	----	623	
Warm Salvage 2	----	----	360	0.2	----	----	----	----
Warm Salvage 3	----	----	351	0.2	----	----	----	----
Warm Salvage 4	----	----	270	0.2	----	----	----	----
Warm Salvage 5	----	----	960	0.5	----	----	408	0.2
Warm Salvage North	----	----	----	----	----	----	22	<0.1
Warm Salvage Mid	----	----	----	----	----	----	13	<0.1
Warm Salvage South	----	----	13	<0.1	----	----	----	----
Warm West 1-4	----	----	457	0.3	----	----	----	----
Warm East 1-4	----	----	----	----	----	----	202	0.1
Warm Fire Road Hazard Tree	----	----	550	0.3	----	----	581	0.3
Wildfire Use/Broadcast Burns	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Plateau Facilities Protection Project	400	0.3	----	----	371	3.1	----	----
Moquitch Rx burn/PCT	----	----	9863	5.5	----	----	----	----
Oquer Rx burn			3473	2.0				
Cancoop Rx burn	4513	3.3						

Table 21. Summary of Activities

Watershed (4th Code)		Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)		White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)		137,282		179,372		119,065		192,974	
	Year	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Past Vegetation Management	1987-2010	5,316	3.9	4,803	2.7	8,209	6.9	8,264	4.3
Past Fire Use Rx Burn	2006-2010	8,809	6.4	7,957	4.4	----	----	12,103	6.3
Wildfires	1987-2009	1,320	1.0	46,214	26	2,081	1.7	18,587	9.6
Livestock Grazing		48,182	35	167,899	94	33,423	28	102,259	53
Proposed Veg. Management		7,488	5.4	7,126	3.9	12,135	10.2	1,585	0.8
Warm Fire Salvage		----	----	2,961	1.7	----	----	1,849	1.0
Warm Fire 20"+/fuel wood		----	----	2,389	1.3	----	----	1,915	1.0
Wildfire Use/Broadcast Burns		4913	3.6	13,336	7.4	371	0.3	----	----

Cumulative effects (CEs) result from the combined effect of multiple activities over space or time. A CE can also be generated by sequential activities on the same site if the initial effect persists and interact with subsequent activities. (MacDonald, 2000)

Ephemeral drainages characterize the drainage network within the analysis area watersheds. There is no perennial or intermittent stream flow. Ephemeral drainages respond to seasonal surface runoff (usually during the snow melt period and the summer monsoon season). Surface runoff potentially carries varying amounts of sediment or turbidity. Turbidity is the water quality standard that is most likely affected by land management activities. Turbidity is a measure of particulate matter in a water sample. In most cases in wildland settings, turbidity is the existence of very fine and fine soil particles in water. Sediment delivery ratios normally decline with increasing watershed area. The larger the watershed area, the greater dilution of sediment and turbidity when assessing impacts from a smaller project area. Arizona Department of Environmental Quality (ADEQ) 2006/2008 305(b) report was consulted to determine water quality status of both the Kanab Creek and Marble Canyon portion of the Colorado River. Kanab Creek and the Marble Canyon portion of the Colorado River were not identified on Arizona's 2006 draft list of 303(d) Impaired Waters.

Vegetation within the analysis area is mostly ponderosa pine, pinyon-juniper, with some mixed conifer and grassland meadows. Portions of the analysis area contain slopes in excess of 40 percent (very steep). However, a significant portion of this analysis area contains slopes ranging from nearly level to strongly sloping slopes and moderately steep to steep slopes. Average precipitation per year ranges from 20 to 25 inches with more than half coming in the form of snow during the period of October 1 and March 30th.

This analysis will consider two kinds of cumulative effects, direct and indirect. Direct effects considered are sediment impacts from roads, gullies, and headcuts. Indirect effects are related to soil condition within the uplands.

- ✓ **Gullies and Headcuts**

Gullies and headcuts are a primary source of sedimentation. They channelize and accelerate sediment-laden water, resulting in soil movement to downslope locations or into drainages. Areas which are sensitive to gully erosion are long, narrow alluvial plains, alluvial fans, and low lying areas with moderate slopes and deep, fine-textured soils. Gullies are typically the result of historical management practices and are now in varying degrees of recovery. As management practices and watershed conditions have changed over time, these dendritic gullies are now adjusting to a more stable condition by aggradation and widening, creating more favorable floodplains and by headcutting to establish a more gentle gradient. This adjustment process involves erosion of banks and headcuts in order to reach a point of equilibruim. Once this point is reached, erosion decreases and gullies stabilize. It is evident that banks are becoming less vertical, grasses and forbs are becoming established within stream channel bottoms and headcuts are becoming more shallow, improving gully stability. The effect is a reduction in soil productivity loss and downstream sedimentation.

Soil condition is generally satisfactory within those areas dominated by ponderosa pine and mixed conifer. Current sheet and rill erosion from forested areas is normally minimal. This is the result of acceptable vegetative ground cover provided by grasses, forbs and shrubs as well as litter including needle casts, oak leaves, and woody debris.

Soil condition typically varies within meadows. Meadows are subjected to concentrated management activities such as livestock grazing, recreation use, roads, etc. which disturb vegetative ground cover, resulting in increased soil loss and compaction.

Vegetative ground cover is usually variable on soils within the pinyon-juniper woodlands. Soil loss may vary depending on surface conditions (soil texture and structure, rock cover, vegetative ground cover, steepness of slope, etc.). Soil loss is generally associated with soils that have less than adequate vegetative ground cover. This is often caused by encroachment of juniper, which decreases effective vegetative ground cover through shading of soil surfaces. Some soil loss in these woodlands is associated with rainfall events that can introduce the eroded sediments into ephemeral channels.

Table 22. Timber Harvest Activities

Watershed (4th Code)		Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)		White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)		137,282		179,372		119,065		192,974	
	Year	Acres	% of WS	Acres	% of WS	Acres	% of WS	Acres	% of WS
Past Vegetation Management	1987-2010	5,316	3.9	4,803	2.7	8,209	6.9	8,264	4.3
Proposed Vegetation Management		8,688	6.3	4,442	2.5	13,676	11.5	1,585	0.8

Project objectives are generally designed to improve forest health by thinning overstocked stands. These activities typically require the use of ground distrubing equipement. Overall, forest thinning and can improve tree growth, increase the diversity and amount of herbaceous understory (including effective vegetative ground cover), and reduce the risk of uncharacteristically intense wildfire. Effects on soil productivity and stability are common to all harvest activities, but vary in silviculture treatments, fuel treatments, and acres treated. Effects are generally related to roads, skid trails, log landings and fuels treatments resulting in varying degrees of soil displacement, compaction and soil loss due to reduced or complete removal of vegetative ground cover. Adequate vegetative ground cover is the primary component that protects the soil from accelerated erosion.

Timber harvesting operations generally occur on relatively gentle slopes (slopes less than 20 percent), however, some minor areas of activity occur on the steeper slopes (20 to 30 percent). It is assumed that between harvest and fuel treatment activities, every acre in each proposed treatment unit is affected. Therefore, the total acreage is assumed to be at risk for some level of soil disturbance. The risk of soil disturbance and accelerated erosion is expected to last until vegetative ground cover conditions have recovered sufficiently to protect soil surfaces,which typically occurs within approximately 3 to 5 years after timber harvest activities are completed.

By identifiying and implementing site-specific BMPs and timber sale contract requirements, effects to soil and watershed resources are minimized and are generally short term (3 to 5 years). Best Management Practices are designed to maintain soil productivity and surface water quality by minimizing soil loss and associated sedimentation of waterbodies. The Beaver Creek Research Watersheds located on the Coconino National Forest showed that changes in water quality were slight and were most noticeable after timber harvest activities. However, long term effects on water quality were minor and water quality continued to meet acceptable surface water quality standards (USDA Forest Service, 1977).

Past, current and proposed vegetation management projects occur in only small percentages of each watershed.

- ✓ **Effects on Soil and Water Resources of the Warm Fire Recovery Project**

The Warm Fire Recovery Project consists of numerous sale units, where fire-killed trees >14 inches in diameter can be harvested. This activity is to occur on 2,961 acres within the Snake Gulch watershed and

1,849 acres of the House Rock watershed. Although the quality of the timber continues to deteriorate, there may be an additional 2,389 acres (Snake Gulch) and 1,915 acres (House Rock) that has fire killed trees exceeding 20 inches in diameter that could be harvested or sold for fuel wood.

Table 23. Warm Fire Recovery Project

Watershed (4th Code)		Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)		White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)		137,282		179,372		119,065		192,974	
	Year	Acres	% of WS	Acres	% of WS	Acres	% of WS	Acres	% of WS
Warm Fire Salvage		----	----	2,961	1.7	----	----	1,849	1.0
Warm Fire 20”+/fuel wood		----	----	2,389	1.3	----	----	1,915	1.0

- ✓ **Soil Hydrology**

Soil compaction and rutting are the primary impacts that affect soil hydrology. Compaction of the soil reduces soil porosity and inhibits water infiltration. The main causes of compaction to soils from the proposed action would be the use of landings (areas where felled trees are collected for removal from the forest on trucks), and the use of ground-based equipment to harvest and yard burned trees from the fire area. These types of equipment typically create skid trails where they collect and retrieve the harvested trees to be dragged to the landings. Multiple passes on these skid trails can create compaction and rutting. Compaction reduces infiltration to the extent where long-term soil productivity on those skid trail locations is negatively impacted. Ruts can channelize runoff and increase erosion and turbidity in surface waters.

Soil disturbance surveys indicate that the current existing percentage of landings and skid trails is approximately 8 to 12 percent of the proposed activity areas. As noted above, most of these skid trails still show compaction and are not exhibiting substantial recovery. In order to avoid further compaction and displacement of soils, the existing landings and skid trails would be re-used. All landings would be ripped, and heavily used skid trails would be decompacted utilizing a disk or other shallow soil decompaction equipment to alleviate reductions in infiltration capacity. Therefore, it is not expected that the percentage of compacted areas would increase substantially (i.e., beyond an additional 1 to 2 percent over the current condition). Further, equipment would mostly be limited to slopes less than 20 percent, and skid trail spacing would be a minimum of 100 feet. Allowances would be made for heavy equipment to move over steep terrain (up to 30 percent) for distances no greater than 100 feet.

Those remaining areas of water repellency, which formed as a result of the Warm Wildfire that may exist would eventually recover as natural processes such as freeze-thaw, root penetration, and chemical weathering take place. After use, landings and skid trails will have appropriate mitigation measures implemented to facilitate soil recovery and improve water infiltration.

- ✓ **Soil Stability**

Soil stability would be improved over approximately 9,114 acres through increases in slope roughness from the added slash at the soil surface. Slash would enhance ground cover and thereby reduce soil particle detachment by raindrop impact. Enhanced ground cover from the addition of slash, and over the longer term from increased understory vegetation, particularly grasses and forbs would improve microhabitat conditions (i.e., shade, moisture, and available nutrients). These improvements would occur on most soil map units due to the current condition of reduced ground cover and post-fire accelerated erosion processes. The Burned Area Emergency Response report estimates recovery of soils to minimum soil tolerance levels would take approximately 3 years from the time the fire ended.

Forest Service Water Erosion Prediction Project (FSWEPP) modeling indicates that erosion rates from harvest and post-harvest fuel treatment activities (piling and burning) would be approximately 0.3 ton per acre per year for slopes 0 to15 percent and 1 ton per acre per year for slopes 15 to 40 percent. The decrease in erosion as compared to the no action alternative is attributable to the increase in soil surface roughness from the introduction of slash and coarse woody debris (CWD), and burn pile sites. Soil condition would improve slightly over time. However, some soils on steeper slopes that are currently rated as impaired or unsatisfactory would not be substantially affected by project activities and would therefore improve at a slower rate than treated areas. Modeled sediment delivery to stream channels would be essentially the same as the erosion rates predicted for the upslope erosion areas. However, these conditions would improve over time, so erosion and sedimentation rates would not be expected to remain constant, but would decrease and stabilize as treated areas recover.

Soils would be less exposed to future accelerated erosion due to the increased soil surface roughness added by residual logging slash. There would be some minor soil displacement from the end lining of logs to skid trail areas on treatment units, although overall, the negative effects would be minimized due to the application of project design features and BMPs (see project design features for soils and watershed listed in chapter 2 of the Final Environmental Impact Statement for the Warm Fire Recovery Project and Soil and Water Conservation Practices (SWCPs) 24.1, 24.13, 24.16 – 24.18, 24.2, 24.21 – 24.24, 24.26, 24.27, 24.29, 24.3, 25.16, 25.18). The effectiveness of these measures has been proven to control and reduce impacts to soil resources and water quality (Ice 2004, Rashin 1994, Seyedbagheri 1996, USDA Forest Service 2004b).

- ✓ **Nutrient Cycling**

Nutrient cycling would improve over time on approximately 9,114 acres due to the addition of small and large woody material. The project would leave at least 15 tons per acre of CWD in the activity units. In addition, up to 5 tons per acre of fine fuels would be left as needles, twigs, small limbs, and other small slash material. The majority of the treatments are proposed for areas where soil organic material was largely removed from most TES map units within the high and moderate/high burn severity areas within the project area. The addition of CWD and other fine fuels would have a beneficial effect to long-term soil productivity (see project design features detailed in section: 10-13 of the Final Environmental Impact Statement for the Warm Fire Recovery Project). The effectiveness of these measures has been proven to reduce and control impacts to soil resources and water quality (Ice 2004, Rashin 1994, Seyedbagheri 1996, USDA Forest Service 2004b).

Table 24. Grazing Activities

Watershed (4th Code)		Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)		White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)		137,282		179,372		119,065		192,974	
	Year	Acres	% of WS	Acres	% of WS	Acres	% of WS	Acres	% of WS
Livestock Grazing		48,182	35	167,899	94	33,423	28	102,259	53

Overgrazing occurred historically in all watersheds. Animal Unit Month (AUM) numbers have been steadily decreasing since the 1980s to achieve range utilization standards. The primary goal of livestock management today is to improve range and watershed conditions. Improved species density and diversity of perennial and herbaceous vegetation, and vegetative ground cover is the result of changes in grazing rotation strategy, improved season of use, and reduced stocking levels. Projects designed to thin dense overstory tree species continue to improve the density, diversity, and vigor of understory herbaceous vegetation, resulting in improved range and watershed conditions.

However, livestock, unless properly herded, tend to congregate in meadows, which may contribute to soil compaction, a change in vegetative species diversity, a loss of vegetative ground cover and an increase in soil loss. In the wetter meadow areas, species diversity may be reduced, favoring the more tolerant grazing species (carex and sedges) and Poas (Kentucky bluegrass) which are more tolerant to grazing pressure. But with reduced livestock numbers and grazing periods within these areas, the adverse effects of livestock grazing on soils are somewhat mitigated.

The location and management of range structural improvements affects soil and water resources. Stock tanks located within meadows attract livestock and grazing wildlife. This usually increases the duration and intensity of grazing impacts as animals congregate, resulting in soil compaction, higher use of palatable vegetation, and loss of vegetative ground cover and species diversity within the associated plant communities. Range structural improvements located in uplands and out of meadow areas have a tendency to draw grazing animals away from sensitive areas, resulting in improved distribution of livestock and reduced grazing impacts to sensitive areas.

Herding and fencing allows for improved control and management of livestock. Improved livestock distribution, reduced time and duration of livestock use and added control of season of use helps to minimize the effects of grazing on soil and water resources. In some areas, livestock may trail along fences but the overall effect is beneficial in terms of livestock control and distribution and reduced livestock impacts upon soil and water resources.

Livestock grazing in the burned areas is generally deferred for 2 years for vegetation and soil protection and is re-initiated using an adaptive management strategy where range conditions can support the use.

- ✓ **Wildfire**

Wildfires have had and will continue to have a significant impact on the analysis area. Wildfires are human caused or are the result of lightning. Land management activities and changing vegetative conditions in the last 100 years have produced an unnatural accumulation of fuels and increased trees per acre. These conditions make wildfire suppression difficult if not impossible .

Table 25. Wildfire

Watershed (4th Code)		Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)		White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)		137,282		179,372		119,065		192,974	
	Year	Acres	% of WS	Acres	% of WS	Acres	% of WS	Acres	% of WS
Wildfires	1987-2009	1,320	1.0	46,214	26	2,081	1.7	18,587	9.6

The effects of wildfire on soil and watershed resources are evaluated by determining burn severity. Burn severity, a term that describes the effects of heat on soil and watershed conditions after a wildfire, is described and summarized in three burn severity classes: low, moderate, and high. Site indicators used to assess burn severity include the degree of water repellent soils, degree of litter and duff consumed, the amount and kind of live vegetation consumed, degree of downed woody material consumed and charred, and post-fire vegetative ground cover.

High and moderate burn severity areas are characterized by loss of vegetative ground cover, a decrease in litter accumulations and other decomposed soil organic matter, and the frequent formation of strongly water repellent (i.e., hydrophobic) soils. Once these areas receive significant precipitation in the form of rain, they become the source areas of accelerated runoff, erosion, and ash flow resulting in surface water quality degradation and increased stream flow discharges. The sporadic nature of ephemeral stream flow

results in sediment and ash being potentially stored within these stream channels and then transported during surface runoff events. Ephemeral stream channels within the high burn severity areas experience a loss in their ability to buffer the runoff from large rainfall events, resulting in increased channel scour and incision caused by accelerated runoff and erosion from severely burned watershed areas.

Another effect is sediment and ash deposition in downstream roads, stock tanks and meadows, even though these areas and adjacent forested areas may not have burned. In addition, sediment and ash-laden overland flows may damage low lying roads by filling culverts and low water crossings. These are examples of why post-fire watershed conditions are significantly different from pre-fire conditions.

In low burn severity areas, effects are mainly light ground char where the litter is scorched, charred, or partially consumed. The duff is largely intact, although it may be charred on the surface. Woody debris accumulations are partially scorched, charred, or consumed. Mineral soil properties are not adversely changed. In fact, low severity fire releases nutrients stored in surface organic matter and live vegetation. These nutrients facilitate rapid reestablishment of vegetative ground cover since root to shoot ratios are improved for grasses and forbs that survive fire, resulting in protection of soils from accelerated soil erosion soon after fire has occurred. Evidence of sheet and rill erosion as a result of low intensity fire is minor. In forested areas, much of the tree overstory is green with some scorch at the base of the trees and in the lower branches following low intensity fire. Most trees survive; however, pockets of seedlings and saplings are often killed or consumed where moderate to high intensity fires occur. While most of the shrubs, forbs and grasses are affected under conditions that could be described as a “cool” burn. In most cases, much of this vegetation survives. Areas identified as low burn severity may also contain large unburned areas, resulting in a mosaic of burned and unburned sites across the landscape.

In addition to fire effects described above, wildfire suppression activities such fire line construction (both hand a machine), and location of wildfire suppression staging areas and camps result in soil displacement, compaction, loss of vegetative ground cover and increased erosion potential. Once a wildfire is deemed under control or the fire is out, rehabilitation of disturbed areas can begin. Firelines are often recontoured, decompacted, water barred and reseeded with an erosion control seed mix suitable for the area. These treatments decrease and disperse overland flow by improving water infiltration and preventing channelization and erosion. Fire camps are scarified or ripped to alleviate soil compaction. This is followed by reseeding with an erosion control seed mix or mulching to protect soil surfaces.

To minimize the effects of wildfire on soil and water resources, an assessment is promptly conducted to determine if fire-caused changes in soil hydrologic function have resulted in an emergency condition that threatens life, health, property, or critical cultural and natural resource values due to flooding, erosion, and debris flows. If necessary, emergency stabilization treatments are prescribed and implemented to minimize post-fire threats and to protect critical values at risk.

Within the CE analysis area, the Warm and Bridger Knoll fires have had substantial effect on soil and watershed condition. Soon after each event, uncharacteristic runoff and soil erosion occurred resulting in both degradation of site productivity, disruption of ephemeral stream channel stability and considerable sedimentation. Within a few years, runoff and soil loss more closely resemble undisturbed conditions as new vegetative cover, including aspen, oaks, grasses, and forbs establish on site. Litter and CWD increase over time as fire killed trees fall, and forest detritus (needles, leaves, twigs, seeds, etc.) are re-introduced. The Snake Gulch watershed was most heavily impacted by these fires.

Table 26. Broadcast Burning and Wildfire Use

Watershed (4th Code)		Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)		White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)		137,282		179,372		119,065		192,974	
	Year	Acres	% of WS	Acres	% of WS	Acres	% of WS	Acres	% of WS
Past Fire Use Rx Burn	2006-2010	8,809	6.4	7,957	4.4	----	----	12,103	6.3
Wildfire Use/Broadcast Burns		4913	3.6	13,336	7.4	371	0.3	----	----

Prescribed fire in the past has been used mostly to treat timber sale generated slash to reduce the future risk of wildfire. Slash created by timber sales is treated to reduce the risk of wildfire, especially within wildland-urban interface areas. Machine piling of slash may not leave sufficient material on the ground to protect soils, but the risk of catastrophic wildfire is reduced. Also, machine piling has the potential to reduce vegetative ground cover and cause displacement of both soil and surface rock. Fuel breaks and urban interface areas receive intensive fuel treatments which may reduce soil productivity over the long term. Prescribed fire is also used as a tool to meet desired resource conditions. The goals of using prescribed fire include: 1) increase grass/forb diversity and amount, 2) assist in recycling nutrients into the soil, 3) maintain similar to existing levels of CWD, 4) maintain an acceptable fire risk, 5) maintain forest cover and developing old growth characteristics in stands designated as such, and 6) promote occasional patches of tree seedlings to contribute to future stand structural and species diversity. Also, wildfire use areas are designated to burn under natural conditions as long as burning occurs under controlled conditions. Suppression action occurs when the fire is burning out of prescription resulting in resource damage such as the 2006 Warm Fire. Prescribed fire therefore has a positive cumulative effect on soils and watershed resources when properly implemented.

- ✓ **Recreation and Other Uses**

Dispersed recreation activities usually occur along existing roads and on or near meadows. The high road density within the analysis area has made the forest more accessible to the public. Intense dispersed recreation use occurs near urban areas and main paved highways. Dispersed recreation activities such as hiking, observing wildlife, camping, picnicking, hunting, personal fuelwood gathering, ATV use, and off-road-vehicle use, etc. have created localized disturbances such as unauthorized roads, trails, and parking areas. The results are primarily soil compaction, soil displacement, loss of vegetative ground cover, and an increase in soil loss in some areas. Forest users seek senic areas and other areas near waterbodies such as stock tanks, springs, and cool, wet areas. The effects on soils and water resources from dispersed recreational activities are evident in some localized areas, however recreation activities are not a major cumulative impact within the analysis area.

- ✓ **Other Lands and Special Uses**

The effects of activities on private lands have not been quantified to the extent that they have been on National Forest lands. Occasionally, construction activities may interfere with natural drainage patterns. State lands are managed for timber production, grazed by both domestic livestock and wildlife, and are used for recreation. Effects on soil and water resources from activities on these lands are generally similiar to those on National Forest lands. Some state lands as well as National Forest lands may contain borrow pits where roadfill material is extracted. However, borrow pits are few in number and usually small in size (i.e., less than 5 acres). Soil compaction is common within borrow pit areas and on access roads where fill material is transported. However, these pits have not been shown to adversely impact adjacent soils and water resources within the project area. There is therefore no cumulative effect from borrow pit in the proposed project area.

Table 27. Summary of JR Project Area as a percentage of Watershed

Watershed (4th Code)	Kanab Creek 15010003						Marble Canyon 15010001	
Watershed (5th Code)	White Sage 15010003-02		Snake Gulch 15010003-07		Lower Johnson 15010003-04		House Rock 15010001-01	
Watershed Acres (5th Code)	137,282		179,372		119,065		192,974	
Vegetation Management	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**	**Acres**	**% of WS**
Jacob-Ryan	7,242	5.3	3,661	2.0	12,093	10.2	1,585	.8

In the case of the JR project's CEs, with the exception of livestock grazing, there is little to no activities occuring on the same site; therefore, there is no site specific spatial cumulative effect. There are, however, a number of activities occuring in the watersheds that are widely distributed in space and time.

As was noted in the direct/indirect effects section (Soils and Watershed Specialist Report, 2011 PR-64), it is expected that there would be a short-term direct or indirect effect due to ground-disturbing activities such as ground-based logging and road maintenance work. The direct or indirect effect is expected to subside and not be measurable within 3 to 5 years after harvest activities cease. With the exception of the Lower Johnson watershed, the JR project occurs on very small percentages of the involved watersheds (see Table 27 above). The Lower Johnson watershed exhibits little disturbance from past activities. The JR project has design elements that will minimize on-site direct and indirect effects to soil and water resources (see Appendix C-2). With implementation and monitoring of BMPs and strict adherence to timber sale contract provisions, and given the existing condition of the proposed project's soil and water resources, implementation of the project will result in no detectable cumulative effect on the status of water quality and soil condition within the spatial and temporal scales identified in this analysis. Improved road maintenance associated with the action alternatives, including maintaining road drainage systems, and rehabilitating existing roads and trails that normally would not be maintained on the Forest Service system would create a net reduction in the long-term cumulative effect.

3.2.4 WILDLIFE

The wildlife section in this EA is a summary of the information provided by the Biological Evaluation/Wildlife specialist report. This document is incorporated by reference into this EA. The report documents existing condition for each species, which species were not required to be analyzed and the species that were brought forward from scoping, management indicator species and migratory birds to be covered under the Migratory Bird Treaty Act.

3.2.4.1 Federally Listed Species

There are 6 wildlife species listed under the Endangered Species Act (ESA) identified by the U.S. Fish and Wildlife Service (http://www.fws.gov/southwest/es/arizona/) for Coconino County that occur on the Kaibab NF. The Forest has developed a list (Kaibab 2010) that breaks down the range of species by District. This section is a summary of the information provided in the Wildlife Specialist Report (2011), which details why species were not carried forward in this analysis.

A **determination of "no effect"** has been made for Apache trout, Mexican spotted owl, Mexican spotted owl critical habitat, and Southwest willow flycatcher since there is no suitable habitat within or adjacent to the proposed JR Project area.

- CALIFORNIA CONDOR

The California condor is a federally listed endangered species, is an experimental, nonessential population in Arizona (USFWS 2002). The California condor was reintroduced to the Arizona Strip starting in 1996, with releases on the Vermillion Cliffs above House Rock Valley, east of the border of the NKRD. Additional releases have occurred in both the House Rock Valley, and the Hurricane Cliffs to the west of NKRD.

Condor use of the NKRD is year-round, including foraging and nesting. However, no eggs have been hatched on the District since the reintroduction of condors to the area in 1996. Depending on the time of year and food availability, the number of condors on the District at any one time may vary. Condors have been extensively radio-tracked and have been detected flying over, foraging and roosting on the District. Condors may use the project area during foraging and resting, but not likely during nesting or roosting activities. Condor Conservation Measures (Appendix A in Wildlife Specialist Report 2011) will be implemented during all phases of the project. The conservation measures are educational guidelines designed to help alleviate human interference with condor behavior. No nesting condors would be disturbed during project implementation, there would be no impact on food availability, and the use of the condor conservation measures would prevent any effects to the California condor. The actions of the project will not jeopardize the continued existence of the California condor.

3.2.4.2 Forest Service Sensitive Species

Forest Service sensitive species are species that are likely to occur or have suitable habitat on forest lands and have been identified by the Regional Forester as a species that require extra protection to prevent them from federal ESA listing. There are 20 wildlife species on the USDA R3 Regional Forester's Sensitive Species 2007 list that occur on the Kaibab NF. The Forest has developed a list (Kaibab 2010) that breaks down the range of species by District. This section is a summary of the information provided in the Wildlife Specialist Report (2011), which details why species were not carried forward in this analysis.

- NORTHERN GOSHAWK

  - ***Existing Condition***

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). Research indicates that the northern goshawk requires areas of mature forested habitat characterized by large trees, closed canopy cover, and an open under-story for nesting area and post-fledging areas, although foraging habitat is highly variable (Reynolds et al. 1992, Crocker-Bedford and Chaney 1988, DeStafano and McCloskey 1997).

The Forest Plan provides specific desired forest conditions and management strategies within the three stratifications of a goshawk's home range; including the nest area (totaling at least 180 acres), post fledgling-family area (PFA) (420 acres), and foraging areas (FAs) or areas outside of PFAs (5,400 acres). The project area consists of a total of 26,000 acres of goshawk habitat, 4,500 in nest areas, 10,300 PFA acres (28 PFAs) and 12,000 FA acres. The density of goshawk territories in the project area is very high, resulting in several immediately adjacent PFAs and overlapping FAs.

The Forest Plan (Forest Plan, page 29) requires that the effects for vegetative structure are assessed at three scales. The analysis for the JR project was conducted at the group level, stratum level and at the larger ad-hoc analysis area. The vegetative analysis at the three levels can be found in the project

Vegetation Resource Specialist Report. Disturbance, canopy cover and VSS distribution within and outside of PFAs were used to compare environmental consequences for all alternatives.

- ***Direct and Indirect Effects***

✓ **Alternative 1 - Modified Proposed Action**

The Modified Proposed Action improves forest health and sustainability by reducing the risk of stand replacing wildfire. Opening up the canopy through regeneration will allow additional moisture and sunlight to reach the ground promoting grass and forbs sprouting. In addition, new open areas create favorable conditions for leave trees to expand their root system for nutrient and moisture intake. This reduces the stress on the remaining clumps and groups of trees enabling them to grow faster and be more resistant to fire, disease and drought. Finally, it provides the space needed for seedling tree regeneration allowing for increased diversity of the herbaceous under-story, and providing for more of a mosaic of age and structural classes that provide functional habitat conditions for a broad spectrum of wildlife species, including northern goshawk prey species.

There are 49 individual nests within the project area that have been used at least once within the last 5 years; some of the nests have been used multiple years. Noise from mechanical treatments are not likely to directly affect nesting goshawks as no thinning activities will occur within ¼ mile from any active nest. There are potential direct effects from prescribed burning that could affect nesting and feeding behavior. Goshawk may be flushed from nest sites and/or change foraging behavior due to smoke accumulation. However, over the years as many as 10 territories/nest areas under-burned during the breeding season (eggs or young in nest) and in none of these cases did the nest attempt fail (Dr. Richard Reynolds, personal communication 2009, observations of fire/smoke on goshawks on the NKRD). Vegetation treatment activities would be seasonally restricted to prevent disturbance at active nests.

Prescribed burning or thinning activities may indirectly affect the goshawk by changing the goshawks habitat structure (snags, downed logs, woody debris, vegetative structural stages, and dense canopy cover). The ad-hoc area, including the project area, is sufficient in coarse woody debris, ~2 snags/acre, 3 downed logs/acre and 9-10 tons per acre of downed woody material. When fire is used as an effective tool, the desired conditions for coarse, woody debris can be obtained. In addition, the proposed activities may change the structure of goshawk prey species' habitat, affecting the abundance and composition of prey species. Although treatments, especially prescribed burning, may have adverse effects to prey species and their habitat in the short term, returning forest structure to a fire adaptive ecosystem may increase diversity of vegetative conditions, which would provide for a diverse prey base in the long-term.

The Modified Proposed Action treatments would help move the forest toward Plan guidelines for VSS at the group level. Treatments described in the Modified Proposed Action would alter VSS class distribution, changing the project area from one dominated by VSS 3 more toward the desired condition. Neither the No Action nor the Alternatives will result immediately in the desired VSS class distribution as outlined in the Plan for the northern goshawk. However, trees are expected to grow into the larger diameter classes at a faster rate with implementation of this alternative especially in the even-aged strata where suppression is currently occurring.

To restore wildlife habitat and meet Plan guidelines treatments will create clumps (up to .5 acre) and groups (up to 4 acres). Treatments in the even-aged stands will focus on creating openings by removing surplus trees. Treatments for uneven-aged stands will focus on thinning throughout all size classes to desired VSS distribution, while aiming to maintain desired canopy cover at the group level. Six northern goshawk prey species prefer an open forest, while seven prefer a more closed canopy, treatments in the Modified Proposed Action will provide for all thirteen prey species (Reynolds et al 1992).

Stand density and site quality influences VSS percentage and the time required to achieve the desired forest structure for goshawks and their prey species. On sites with the same site quality, tree diameter growth will vary with different management intensities. The number of years in VSS 4, 5, and 6 are longer for the sites with lower stand density index (SDI). SDI is a measure of the stocking of a stand of trees based on the number of trees per unit area and diameter at breast height of the tree of average basal area; see Vegetation Resource Specialist Report, 2011. When conditions are beyond the average SDI the site is fully occupied and competition-induced mortality is occurring with limited understory production. One desired forest structure condition is to maintain 40% of the goshawk post-fledging family and foraging areas in VSS 5 and 6 to sustain moderate to high populations of key prey species. Current SDI (300 in PFAs and 289 in FAs) is too high to sustain the upper VSS pine structure. These older age classes maintain the most species at an abundant population level (10 of 12 species found in ponderosa pine forests: i.e., woodpeckers, chipmunks, tassel-eared squirrels) (Reynolds et al. 1992). Since forest stands reach VSS 5 and 6 from 30 to 70 years earlier in stands with lower density the desired forest structure could be maintained for a longer period of time. The nest area is a key component of goshawk home territories, under the Modified Proposed Action, goshawk nest sites (30 acres each) have a current site index of 68, and a 50-60% canopy closure would be maintained preserving large patches of mature forest.

The maintenance of forest stands that will develop into mature seral stages around nests should increase the likelihood of continued breeding pairs within the project area. Following the forest plan and hence the goshawk guidelines are likely to be beneficial to northern goshawks. The Modified Proposed Action may temporarily impact individuals but will not cause a trend towards future listing for northern goshawk.

- ✓ **Alternative 2- No Action**

Under the No Action Alternative no mechanical treatments or prescribed burning would occur. This alternative would have no direct effect on goshawks. However, the stands with dense even-aged trees would remain stressed, decreasing growth and increasing the susceptibility to drought disease and infestation (i.e. bark beetles).
Moore et al. (2006) found that restoration treatments of thinning and burning increased herbaceous standing crop in just 2 years. Under the No Action Alternative, the under-story species diversity is likely to decrease, limiting foraging potential and habitat suitability for goshawk prey species. Over time, these conditions could result in reduced wildlife species diversity, and hence affect goshawk reproductively (Salafsky et al. 2005).

Indirect effects of the No Action Alternative are decreased habitat suitability, decreased foraging opportunities, and continued risk of habitat loss from stand replacing fire. Stand replacing fires such as the Warm Fire of 2006 had high vegetation mortality, burning 53% of the total PFA habitat on the district (USDA Forest Service 2007). Four of 8 known active nests were in areas characterized by high vegetation mortality crown fire, and at least 7 nestling/fledgling goshawks were likely killed by the fire (Dr. Richard Reynolds USFS, personal communication 2010, effect of Warm Fire on NKRD NOGO population). Vegetative structural stage distributions as outlined in the Plan would not be attained. The No Action Alternative, or no management of a non-natural ecosystem, will not affect individuals and will not cause a trend towards future listing for northern goshawk, but will also not benefit the species.

- ✓ **Alternative 3**

Alternative 3 proposed treatments would not meet Plan guidelines for VSS at the group level. Treatments would alter VSS class distribution, changing the project area from one dominated by VSS 1-3 more toward the desired condition. Alternative 3 may result in the desired VSS distribution by the end of the 20-year planning period.

This alternative modifies the Modified Proposed Action by allowing tree thinning and removal only up to 16 inches DBH. The effects to even-aged stands will be similar to those of the Modified Proposed Action.

Dense stands in Alternative 3 are more prone to insect and disease attacks, especially from bark beetles. Overtime this alternative may establish a greater number of larger trees (VSS 4/6) with interlocking canopies, but not necessarily structured in clumps and groups of trees given the current number and spacing of trees that are over 16 inches in diameter. In addition, this alternative treatment does not provide enough suitable open areas to facilitate root growth for seedling regeneration or reduction in the overall fire risk across the landscape (Abella et al. 2006). This alternative does not meet forest plan and hence does not meet the goshawk guidelines. The Alternative 3 may temporarily impact individuals but will not cause a trend towards future listing for northern goshawk.

➢ BALD EAGLE

- ***Existing Condition***

On NKRD the bald eagle occurs as an occasional winter migrant or visitor, however, no bald eagle nests have been documented. A limited number of individuals are typically seen each year, usually within open meadow habitat or along the highways where they find and feed on dead livestock or road-killed deer or are sighted hovering over mule deer winter ranges where presumably they feed on hunter and winter killed deer. Occasionally, individual eagles are also observed during the winter at Big Springs Administrative Site, where they feed on rainbow trout from the ponds. Bald eagles typically select the larger and more accessible trees for winter roosting. Winter roost sites vary in their proximity to food resources (up to 33 km). Nankoweap in the Grand Canyon to the Southeast of NKRD is a known winter congregation of bald eagles feeding on fish. Eagles will avoid areas with nearby human activity and development (Buehler et al. 1991).

Plan guidelines will be followed to allow for snag recruitment and retention of all existing snags, as feasible. Additionally the National Bald Eagle Management Guidelines will be implemented during all phases of the project.

- ***Direct and Indirect Effects***

✓ **Modified Proposed Action and Alternative 3**

Migratory bald eagles typically arrive in northern Arizona in October and leave in April with adults more common in fall and immature birds more abundant in January through April (Grubb 2003). Eagles will avoid areas with nearby human activity and development (Buehler et al. 1991). Direct effects to bald eagles may occur from disturbance associated with implementing proposed activities such as mechanical treatments and prescribed burning. Indirect effects from smoke may temporarily displace roosting bald eagles. However project implementation is not likely to occur during the winter when eagles are most present. Indirect effects may occur from the loss of snags due to prescribed fire, however snag mortality during prescribed fire usually only occurs on older, weaker snags (ERI 2007). The two alternatives and their associated activities will not affect or cause a trend towards future listing of bald eagles or their habitat.

✓ **No Action**

Under this alternative, habitat conditions would remain on the current trajectory. The forest will become increasingly dense with smaller size classes of trees, thereby limiting the development of larger diameter trees important for roosting. The risk of stand replacing fire will continue to place potential bald eagle roosting and foraging habitat at risk. The No Action Alternative will not affect individuals and will not cause a trend towards future listing for bald eagles.

- BATS (SPOTTED, ALLEN'S LAPPET-BROWED, PALE TOWNSEND'S BIG-EARED)
  - ***Existing Condition***

In August 1995 and July 1996, Rabe et al. (1998) captured and placed radio transmitters on twelve spotted bats on the district south of the Jacob Ryan project area. The bats were captured over small ponds in sub-alpine meadows. One spotted bat was radio tracked to its day roost in the cliffs above the Colorado River and repeatedly foraged in open areas on the plateau surrounded by ponderosa pines. In 2010, during a coordinated effort with NKRD, AZGFD and NAU (Dr. Carol Chambers) two lactating female Allen's lappet-browed bats from ponds in the ponderosa pine were trapped and tracked to maternity colonies up to 17miles away; the same location another bat was tracked to by Chambers in 2005. Pale Townsend's big-eared bats are lepidopteron specialists; their diet consists of 90 percent moths (AZGFD 2003). They are cave roosters and have been captured on the NKRD while foraging in open meadows and over stock tanks. All three bats roost outside of the project area, however all three may use the project areas 35 waters.

- ✓ **Modified Proposed Action and Alternative 3**

Prescribed burning may result in a temporary loss of foraging habitat. Short-term indirect effects would result from vegetation modification activities such as thinning and broadcast burning. These activities would disturb or remove understory vegetation, in effect reducing availability to insects. However, Waltz and Covington (2004) found a marked increase in butterfly (lepidopteron), the main prey species of Pale Townsend's big-eared bat in thinned and burned areas. Overall benefits in treatment areas will occur due to the reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor for the action alternatives. The resulting groups of trees interspersed with openings and interspaces will encourage the development of understory vegetation, increasing availability of food for these species over the long-term. Furthermore Abella et al. (2006) found that understory biomass can be >10 times higher in remnant and restored openings, and that retaining extra trees because of diameter caps, as proposed in Alternative 3, decreases understory productivity and diversity. The Modified Proposed Action and Alternative 3 will not cause a trend towards future listing of the three forest sensitive bats or their habitat.

- ✓ **No Action**

Under this alternative habitat conditions would remain on the current trajectory. The forest will become increasingly dense with smaller size classes of trees. The risk of stand replacing fire combined with an increasingly dense forest will continue to place foraging habitat at risk. There would continue to be a lack of understory, especially in the even-aged stands limiting prey species diversity in the future. The No Action Alternative will not affect individuals and will not cause a trend towards future listing for bats.

- KAIBAB SQUIRREL
  - ***Existing Condition***

The Kaibab squirrel is a geographically isolated subspecies of the Abert's squirrel and an obligate resident of ponderosa pine forests (Dodd et al. 2003). Kaibab squirrels are highly dependent upon ponderosa pine habitat. The squirrel occurs only on the Kaibab Plateau and is found throughout the project area. Nests are usually located in the branches of large pines and in witches' brooms; large tufts frequently cause my mistletoe, anywhere from 16 to 90 ft. above the ground (Hoffmeister 1986). 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. The selected nest tree is usually a larger tree (greater than 67 centimeters or approximately 26-inches in diameter) within the center of a group of trees with interlocking crowns.

Integrated stand management as described above had a direct negative effect to Kaibab squirrels on the NKRD (William Hurst USFS retired, personal communication 2008, personal

observations as a NKRD employee compared with observations today). Current management direction is to restore ponderosa pine forests to conditions that resemble pre- settlement conditions. Pre-settlement prescriptions may reduce short- and long term patch-scale canopy closure, tree density, diversity, and patchiness important to canopy-dependent wildlife (Chambers and Germaine 2003, Dodd et al. 2003). Thinning guidelines in the Plan including promoting varied, irregular spacing between trees and promoting interlocking tree crowns are designed to protect and sustain a wide variety of species including the Kaibab squirrel. Dodd et al. (2003) found that an interlocking canopy is related to squirrel density and recruitment at the patch-scale. Patton (1975) reported that 92% of the squirrel nests were found in trees growing inside a group, with 75% having three or more interlocking canopy trees. These interlocking canopies provide nesting habitat, travel corridors, and help maintain soil moisture for fungal growth.

- ***Direct and Indirect Effects***
  - ✓ **Modified Proposed Action and Alternative 3**

Thinning under the Modified Proposed Action and Alternative 3 would result in a mosaic of interspersed vegetative structural stages creating groups and clumps with retention of crown connectivity. Direct effects are short-term disturbances to nest sites during vegetation treatments and prescribed burning activities. These effects are expected to be limited in area and duration. A possible adverse indirect effect may result from reduced truffle production caused by decreased canopy closure (3-4 %) immediately following treatment (Dodd et al. 2003). This effect is expected to be short-term since the primary objective of vegetation management activities are to promote natural tree grouping with interlocking crowns and high canopy cover. Although the project includes treating mistletoe infected trees, effects to wildlife are expected to be minimal given project design of isolating infected trees as needed for wildlife. Garnett et al. (2006) found only 17% use of brooms surveyed and that was in trees >67 cm (26" DBH). In addition, during timber marking activities, pre-implementation, trees with active squirrel nests are avoided. Possible positive indirect effects are the long-term increase in overall habitat sustainability and reduced risk of wildfire. The Modified Proposed Action and Alternative 3 may impact individuals but will not cause a trend towards future listing of Kaibab squirrels**.**

  - ✓ **No Action**

There would be no direct effects under the No Action Alternative. Indirect effects to this species are expected over time as overstocked stands are prone to disease and insect infestation and have decreased cone production. The No Action Alternative will not affect individuals and will not cause a trend towards future listing for Kaibab squirrel.

3.2.4.3 Management Indicator Species

A Forest-wide assessment entitled "Management Indicator Species of the Kaibab National Forest: Population Status and Trends Version 3.0" (USDA Forest Service 2010) summarizes current knowledge of population and habitat trends for species identified as MIS for the Kaibab National Forest. All MIS species that have habitat within the JR Project area are associated with the ponderosa pine forest type. This section is a summary of the information provided in the Wildlife Specialist Report (2011). There are 515,148 acres of ponderosa habitat type forest wide, approximately 220,000 (43%) of that is late-seral ponderosa pine while 40,000 is considered early–seral (7%, USDA Forest Service 2010). The JR Project area consists of 26, 916 acres or about 5% of the forest-wide ponderosa pine habitat, including 12,806 acres (6% forest wide) late-seral habitat and 4,632 acres (11% forest-wide) early-seral habitat. MIS within the Jacob-Ryan Project area are as follows:

- NORTHERN GOSHAWK

The Kaibab Plateau has historically held one of the most concentrated populations of goshawks known in North America. Goshawks are relatively abundant and widespread, and although population trends are difficult to determine, there is no hard evidence of purported decline in the west (NatureServe

2010). On the North Kaibab, northern goshawk territories have been monitored every year since 1991 and the decline of breeding pairs that reached an all-time low in 2003 has steadily been increasing. Potential management impacts and population trend data are summarized at the forest-level in USDA Forest Service (2010 page 26).

- ***Direct and Indirect Effects***
  - ✓ **Modified Proposed Action**

Implementation of the Modified Proposed Action and Alternative 3 in nest stands is to thin from below maintaining crown connectivity and the larger tree sizes. In FAs, habitat would be managed, as described in the Forest Plan, for about 40+% in VSS 4, 40+% in VSS 5, and 40+% in VSS 6. The Foraging Areas would be more open after the Modified Proposed Action as evidenced by basal area ~ 76 square feet per acre, but would still have crown connectivity in the groups. Canopy cover at the group level would be maintained with the Modified Proposed Action in PFAs following Forest Plan guidelines. The change in structural quality of will help sustain the goshawk population and its prey on the North Kaibab and maintain current forest trends, but overall there should be no effect to the condition of the late-seral pine habitat. The effect of converting ~579 acres of VSS 5 and VSS 6 areas to VSS 1 in the ad-hoc area including the project area adds about 1% to the existing VSS 1 class, and reduces the percentage in VSS 5 and 6 by ~ 1%. The Modified Proposed Action maintains the forest-wide habitat late-seral ponderosa pine. The Action Alternatives are not likely to alter current forest-wide habitat or population trends.

  - ✓ **No Action**

No direct effects are expected to the northern goshawk from this alternative. Over time under all alternatives, the lower VSS classes are likely to increase and are likely to continue to exceed the Plan recommendations. VSS 4, 5 and 6 may increase slightly in the short-term however, due to the continued overstocking; conditions are likely to become more susceptible to disease and fire risk (Vegetation Resource Specialist Report, 2010).

➢ <u>HAIRY WOODPECKER</u>

Hairy woodpeckers are strongly associated with burned areas (Covert-Bratland et al. 2006), an important historical component of northern Arizona's forests resulting from a frequent fire interval (Covington et al. 1997). Several studies have shown that hairy woodpeckers select dead and dying trees for foraging more often than live trees. Although they may forage in burned areas they prefer forests with dense canopies (Bushman and Therres 1988). They use cavities for roosting and winter cover and may excavate new cavities in fall to be used for roosting (Sousa 1987). Plan guidelines will be followed to allow for retention and recruitment of snags sufficient for hairy woodpecker nesting and foraging. Potential management impacts and population trend data for this species are summarized in USDA Forest Service (2010 page 33).

- ***Direct and Indirect Effects***
  - ✓ **Modified Proposed Action and Alternative 3**

Plan recommendations snags would provide necessary habitat for the hairy woodpecker. Large snags are to be maintained to reach the recommended levels of the Plan, at least 2 snags >18 inches DBH, if Plan numbers cannot be achieved, then snag recruitment may be implemented. Current Forest Service management practices recognize the value of snags, and with the exception of hazard trees, snags are not selected for removal during vegetation management activities.

Since the effects are so similar between alternatives, the Forest and District trend changes are expected to be similar. District levels would remain higher than Forest and historic levels with implementation of the proposed alternatives. Although there is a small risk to snags from prescribed fire activities; Pope (2006) found a five-fold increase in the density of woodpeckers in prescribed low-

intensity burned areas. Hairy woodpecker numbers would remain stable at the Forest level because snag densities and other components of the ecosystem used by the species would not change appreciably from this project. Modified Proposed Actions are not likely to alter forest-wide habitat or population trend for this species.

- ✓ **No Action**

Under No Action alternative, there may be a slight increase in snags as forest conditions continue to deteriorate from insect disease and overcrowding. Although woodpeckers may benefit from the increase in snags, forest conditions may negatively affect woodpecker prey base.

- ➢ Pygmy Nuthatch

The Pygmy nuthatch is one of the most abundant species in ponderosa pine forests (Kingery and Ghalambor 2001). They are primary and secondary cavity-nesters, excavating dead and well-rotted wood in addition to using existing cavities. They use large tree-cavities for colonial roosts and therefore need large snags or live trees with dead/decaying parts. Pygmy nuthatches are primarily insectivorous. Potential management impacts and population trend data for this species are summarized in USDA Forest Service (2010 page 52).

- ▪ ***Direct and Indirect Effects***
  - ✓ **Modified Proposed Action and Alternative 3**

Treatments from the Modified Proposed Action and Alternative 3 would open current tree and canopy conditions; reduce threats from insects, disease, and fire; and ensure a consistent supply of trees entering the largest DBH classes through time. In areas that were treated with thinning and prescribed burns or have been thinned and burned naturally, pygmy nuthatches are likely stable to increasing (Forest Service 2010.). Modified Proposed Actions are not likely to alter the forest-wide habitat or population trend for this species.

- ✓ **No Action**

Pygmy nuthatches are cavity-nesters that require dead trees. Allowing current forest conditions to continue developing would likely maintain snags levels and provide 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.

- ➢ Wild Turkey

Currently, wild turkeys occur throughout most of the state's forested regions including the Kaibab Plateau. Hens with young roost under large trees within forests containing a dense under-story that adequately conceal the birds (Mollohan et al. 1995). Potential management impacts and population trend data for this species are summarized in USDA Forest Service (2010 page 62).

- ▪ ***Direct and Indirect Effects***
  - ✓ **Modified Proposed Action and Alternative 3**

The goal of the Modified Proposed Action and Alternative 3 to create a mosaic of tree groups and clumps with interlocking crowns and interspersed with openings would meet the needs of wild turkeys by providing suitable foraging, nesting, brood-rearing, and roosting cover. The change expected to mature ponderosa pine used by turkeys would be discountable. Modified Proposed Action and Alternative 3 are not likely to alter the forest-wide habitat or population trend of this species.

- ✓ **No Action**

There are no direct effects expected to turkeys under the No Action alternative. The estimated trees per acre would increase slightly. Potential negative indirect effects to this species would include reduced herbaceous and shrub cover through competition with and shading by increased pine tree

densities and increases from the threat of fire relative to roost stands. Mature ponderosa pine VSS composition would decline slowly through time compared to the Modified Proposed Action and Alternative 3.

➢ Mule Deer

Mule deer are a generalist species in addition to ponderosa pine, aspen and pinyon-juniper habitats they will also use mixed-conifer, woodland, and chaparral habitats. The project area is considered summer range and fawning habitat for mule deer.

- ***Direct and Indirect Effects***
  - ✓ **Modified Proposed Action and Alternative 3**

The Modified Proposed Action and Alternative 3 will create early-seral habitat from creating areas of regeneration, to move even-aged stands to uneven-aged stands. Some regeneration will also occur in uneven-aged stands as openings are created to enhance grouping from the Modified Proposed Action. Improvement of forage within all treatment areas will slightly reduce grazing pressure on deer forage, but would not lead to a change in trends for animals or forage at the forest-wide level. The Modified Proposed Action and Alternative 3are not likely to alter the forest-wide habitat or population trend of this species.

  - ✓ **No Action**

No direct effects are expected to mule deer from the No Action alternative. Indirect negative effects include the decline of early-seral pine habitat, reduced under-story browse and herbaceous cover and increased risk of wildfire. No changes to the current forest-wide population or habitat trend for mule deer are expected from the No Action Alternative.

➢ Tassel-eared (Kaibab) Squirrel

The Plan designates the Kaibab squirrel as a management indicator species for early-seral stage ponderosa pine forests. However, the Kaibab squirrel uses a variety of age classes and research has shown strong habitat associations with mature ponderosa pine for nesting, foraging and movement. The selected nest tree is usually within the center of a group of trees with interlocking crowns. Potential management impacts and population trend data for this species are summarized in USDA Forest Service (2010 pages 88).

- ***Direct and Indirect Effects***
  - ✓ **Modified Proposed Action and Alternative 3**

The Kaibab squirrel will benefit from both proposed alternatives. Treatments will be prescribed to retain a mixed age class forest with a significant mature tree component. The goshawk management recommendations were designed to benefit key goshawk prey species, including the Kaibab squirrel. A primary objective of vegetation management is to promote natural tree grouping with interlocking crowns and high canopy cover, desired by the Kaibab squirrel. Positive long-term indirect effects include increased habitat sustainability and reduced risk of wildfire. Habitat conditions in the short-term for the squirrel will decline from disturbance within the project area, but in the long-term will provide an increasing trend within the project area. Further detailed effects of the proposed project can be found above (page 10). Modified Proposed Action and Alternative 3 are not likely to alter forest-wide habitat or population trend for this species.

  - ✓ **No Action**

Under the No Action Alternative there is an estimated gradual decline in habitat as tree densities continue to increase, and growth slows. There are no negative direct effects expected to the squirrel. Potential negative indirect effects include a reduction of suitable habitat and risk of stand replacing fire.

3.2.4.4 Migratory Birds

We considered potential effects of the JR project on Arizona Partners in Flight (PIF) Priority Species (Latta et al. 1999) and U.S. Fish and Wildlife Service Birds of Conservation Concern (USFWS 2008). There are no designated Important Bird Areas on the NKRD. The NKRD is within the Southern Rockies Colorado Plateau (#16) bird conservation region. The forest developed a white paper to show which species are on the forest by vegetation type (Kaibab 2010).

Not all species described below have been located on the district, but they have the potential of occurring there. Only ponderosa pine habitats are found within the analysis area.

- Ponderosa Pine Habitat

The priority species in the ponderosa pine habitat type include northern goshawk, Cordilleran flycatcher, olive-sided flycatcher, and purple martin (Latta et al. 1999). FWS list also included the flammulated owl, Grace's warbler, Lewis's woodpecker and Cassin's finch (USDI 2008). The goshawk is discussed in the Forest Service Sensitive Species section.

Alternatives 1 and 3 project implementation activities would be provide a risk of incidental mortality of birds due to the use of heavy equipment and running over or into nest, felling of trees during thinning, and prescribed burning. These activities could cause the loss of eggs or nestlings.

The level of incidental mortality caused by project implementation activities would be proportional to how many acres are treated during the spring nesting season of April, May, June, and July. Seasonal restrictions under Alternatives 1 and 3 would limit project implementation activities between March 1 and September 30 in active goshawk nest areas, which would reduce potential of mortality for species listed in ponderosa pine habitat. Most of the prescribed burning on the NKRD occurs during the fall, outside of the spring nesting season. Implementation of Alternative 1 or 3 would result in some level of incidental mortality (unintentional take) of some birds. Since only a small percentage of habitats would be treated at any one time, the removal of any eggs or fledgling would not result in a measurable negative effect to the birds populations listed above.

Under the No Action alternative, there would be no risk of incidental mortality of birds as a result of project implementation activities. Risk of large-scale, high-severity crown fire would increase under Alternative 2, and high-severity wildfire would result in long-term habitat loss/degradation for nearly all of the bird species listed above.

3.2.4.5 Specially Designated Areas

- Kaibab Squirrel National Natural Landmark (NNL)

In 1965, 278,459 acres of ponderosa pine forest within the Kaibab National Forest and Grand Canyon National Park were designated as the Kaibab Squirrel National Natural Landmark. National Natural Landmarks (NNLs) are designated by the Secretary of Interior and represent unique examples of ecological and geological features that comprise our nation's natural history. The NNL designation is not a land withdrawal and does not direct or prohibit any activity. NNLs are reviewed by the National Park Service. Direction for these areas requires federal agencies with NNL designations to consider the unique properties of the NNL in their planning and impact analysis (Fed. Reg. 64: 25718) and provides opportunities to secure funding and construct partnerships to achieve management and conservation goals. The Kaibab Squirrel NNL was designated for the Kaibab squirrel and for its largely intact example of the western climax community of ponderosa pine. The vegetation management efforts for the JR Project are focused on returning the ponderosa pine forest to conditions that more closely resemble pre-

settlement conditions. The desired forest characteristics follow the goshawk recommendations, which include identification of the special habitat needs for the Kaibab squirrel. The objective is to manage for a sustainable ponderosa pine community, including healthy populations of Kaibab squirrels. The Modified Proposed Action will have no lasting impact on the habitat of Kaibab squirrels on the NKRD within the Kaibab Squirrel National Natural Landmark. The conditions of the Kaibab Squirrel NNL have been satisfied by the design and provisions of this project to provide protection for the squirrel and its habitat by assuring habitat conditions continue for reproduction as provided by the Secretary of the Interior.

- Grand Canyon Game Preserve

The JR Project is located within the Grand Canyon National Game Preserve (GCNGP), which was established by President Proclamation by Theodore Roosevelt on November 28, 1908 to protect game species and their habitat on the Kaibab Plateau (USDA Forest Service 2009). Section 1 of the Grand Canyon Game Preserve Act states "The Reserve should be set aside for the protection of game animals and be recognized as a breeding place therefore." 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 JR Project is located in Game Management Unit 12A, game species within this unit that overlap with the proposed project include: Merriam's turkey, mountain lion, mule deer and Kaibab squirrel. The NKRD worked with the Arizona Wildlife Linkages working group to identify important corridors on the Kaibab Plateau. Due to the lack of private property, away from major roads, no corridors were identified. Wildlife movements specifically Kaibab deer is widespread across the District. Cumulatively the short term temporary use of roads and skid trails will not add to any negative impacts to wildlife.

The Modified Proposed Action will have no lasting impact on the population or habitat of huntable species on the NKRD within the Grand Canyon Game Preserve. The conditions of the Game Preserve have been satisfied by the design and provisions of this project to provide protection for these species by assuring habitat conditions continue for reproduction, and that legal hunting is under the direction of AZGFD as provided by the Secretary of Agriculture.

3.2.4.6 Cumulative Effects

Besides the effects already discussed, there is also a need to consider the effects of the Modified Proposed Action in combination with past actions and reasonably foreseeable future actions. Figure 11 and Table 13 show the cumulative actions for the JR Project and ad hoc analysis area, as defined in the EA. Additionally projects including portions of the Warm Fire suppression, Hazard tree removal project and the proposed Warm Fire recovery project where portions are outside the ad hoc area were also considered. Those that are outside of the ad hoc area are in the longer-interval, higher intensity fire regime and in the mixed conifer habitat type. The JR project would not contribute significantly to the cumulative negative effects of any of the analyzed species. However some of these projects have provided a positive cumulative effect to many of the species including goshawks by opening the understory from fire.

Table 13 summarizes the cumulative effects for each species and the projects that contribute to those effects. The rest of this analysis will describe effects from those projects.

A. The effects from the creation of even-aged stands from past timber sales has been mentioned for each species since some of those even-aged stands are present in the project area. Benefits will occur by the treatment of even-aged stands within the project area however, within the ad-hoc area the negative effects

of even-aged stands including the fire risk, lack of penetrability and lack ground cover will still be present.

B. The fires and subsequent Willis and Hidden Salvage sales are moving towards a desired condition that we are attempting to achieve with the Modified Proposed Action. On the eastern drier slopes grass and shrubs are developing. Regeneration of un-even aged stands is occurring on the top and western slopes, the areas have a beneficial oak component, VSS 1-3 are returning and there is a remaining over-story of VSS 4-6, providing beneficial effects to early-seral species.

C. The Warm Fire Wildland Use portion achieved the desired resource benefit objectives. It increased forage availability and enhanced existing conditions benefiting late-seral species.

D. ADOT Hazard Tree Removal of fire-killed trees along highways will increase visibility of motorists and reduce the potential for road kill of carrion foraging wildlife. There will be removal of snags but the buffer of retained snags from the Warm Fire Recovery Project should mitigate the loss.

E and O. Forest Service Road Hazard Tree Removal within the Warm Fire Use portion – see ADOT tree removal, projects are solely for the purpose of public health and safety.

F. Fracas Wildlife Project is a habitat enhancement project with thinning from below that should benefit late-seral species.

G. North Kaibab Travel Management is in the process of identifying a minimum road system which should limit road impacts to wildlife species including habitat degradation, loss and fragmentation.

H and R. Plateau Facility Fire Protection Project is a fuel reduction project, reduction actions have not been determined at this time.

I and M. Warm fire Suppression actions were limited given the high intensity of the fire but approximately 30 miles of fire line was created and shortly reseeded through BAER (Burned Area Emergency Response) funding, which has improved soil stabilization and forb growth.

J and N. Warm Fire Recovery Project of salvage logging may be assigned to three broad categories: (1) altered stand structure complexity, due to removal of standing dead trees or snags; (2) altered ecosystem processes and functions; and (3) altered populations of species and community composition (Lindenmayer and Noss, 2006). However, due to the loss of habitat from the actual fire and the project design criteria (including a snag buffer and retaining all live foliage trees) effects to species are expected to be minimal.

The effects of the 58,000-acre Warm fire during the summer of 2006 appear to be moving in a positive direction with aspen, forbs, and grass growth already being noted. Given the home range size and foraging requirements for most species, the Warm fire suppression and recovery and the hazard tree removal projects outside the project area within the mix-conifer habitat type do not support the same population of species that are in the Jacob Ryan project area. Deer, mountain lion and some avian species are the only species that may be affected by the actions that have occurred outside the projects area. Salvage activities would have some affect to cavity nesting species, but project design including the retention of 3-5 snags per acre and 5 logs per acre would maintain more habitat for those cavity species then pre – Warm fire conditions. The natural recovery of growth has been an attractant to maintain the summer deer herd. Given the site visibility and the congregation of deer in the Warm fire suppression area it is likely that Mountain lions are experiencing a benefit in forage success.

K and P. Moquitch is a wildlife habitat improvement project. The area was burned in the 70s and aerial seeded, the seeding was effective basically creating a dense even-aged small tree stand ("pygmy forest") within 500 acres. The denseness of the stands and the lack of vegetation on the ground amounts to poor habitat conditions and very little wildlife are found within the area. The proposed project will open up the stand and move the area to un-even aged conditions. The rest of the project area has not had fire or other vegetation treatments and the regeneration growth is heavy leaving the area susceptible to crown fire.

L and Q. Cancoop is in the early planning stages, but will be treating ponderosa pine and pinyon-juniper habitat.

Table 28. Cumulative effects of past, present and reasonably foreseeable effects on wildlife species.

Species	Past Effects	Present and Reasonably Foreseeable Effects	Cumulative Effects	Projects (Table 13) Contributing to Cumulative Effects
Northern Goshawk	Much of the landscape within the projects area is a result Forest Plan direction prior to 1996. Effect to prey species most common, requiring a need to forage opportunistically.	Short-term disturbances from project implementation. Long-term benefits provided by better forest conditions.	A decrease in fire risk and the creation of groups with adequate rooting zone spacing and openings benefiting prey species.	A-Q
Bald Eagle	An increase of snag creation benefitting wintering bald eagles.	Short-term disturbances to wintering bald eagles that are foraging during project implementation Potential reduction in the number of increased perch sites along winter foraging areas.	Cumulatively, these activities combined with this project's activities will not affect reproduction or the overall range of the bald eagle	D, E, J, N, O
Spotted Bat	Reduction of under-story vegetation and insect forage availability from past activities.	Short-term disturbances from project implementation.	Cumulatively the creation of opening may increase under-story vegetation and insect forage.	A, C, F, K, L, P, Q
Allen's lappet-browed Bat	Past activities may have provided an increase in snags.	Short-term disturbances from project implementation. Potential reduction of roosting snags	Project design and plan guidelines for snag retention will reduce any negative cumulative effects.	C, H, I, L, M, Q, R
Pale Townsend's Big-eared Bat	Reduction of under-story vegetation and insect forage availability from past activities.	Short-term disturbances from project implementation.	Cumulatively the creation of opening may increase under-story vegetation and insect forage.	A, C, F, K, L, P, Q
Kaibab Squirrel	Previous projects enhancing higher basal areas that provide high quality nesting habitat.	Short-term disturbances during project implementation, long term benefits associated with creating groups of interlocking crowns.	Cumulatively forest trends should be stable and or up.	A, F, H, K, R

Species	Past Effects	Present and Reasonably Foreseeable Effects	Cumulative Effects	Projects (Table 13) Contributing to Cumulative Effects
Migratory Birds	Reduction of under-story vegetation and insect forage availability from past activities. Snag removal (Purple martins).	Short-term disturbances from project implementation	Creation of opening may increase under-story vegetation and insect forage and project design should reduce any negative cumulative effects.	A, C, F, K, L, P, Q
Pygmy Nuthatch	Reduction of roosting snags	Short-term disturbances from project implementation and Direct impacts from proposed fuel treatments which may cause a loss of snags in analysis area.	Project design and plan guidelines for snag retention will reduce any negative cumulative effects.	E, F, K, M, N
Wild Turkey	Reduction of under-story vegetation and insect forage availability and potential roosting sites from past activities.	Short-term disturbances during project implementation, long term benefits associated with creating roosting tree groups.	Cumulatively the creation of opening may increase under-story vegetation and insect forage and the development of understory vegetation.	A, C, F, K, L, P, Q
Mule Deer	Overall increase of under-story vegetation/forage availability from past activities within summer range.	Short-term disturbances during project implementation on mule deer summer grounds.	Cumulatively activities do not affect the reproduction or overall distribution of mountain lions.	A-R

3.2.5 Sensitive Plants

Forest Service sensitive species are species that are likely to occur or have suitable habitat on forest lands and have been identified by the Regional Forester as a species that require extra protection to prevent them from federal ESA listing. There are 18 sensitive plant species on the USDA R3 Regional Forester's Sensitive Species 2007 list that occur on the Kaibab NF. The Forest has developed a list (USDA Forest Service 2010) that breaks down the range of species by District. None of the listed plants have suitable habitat within or near the large scale ad hoc JR Project boundary, thus no affects to Forest service sensitive plants is likely (Botany Specialist Report, 2010 PR-30).

3.2.6 Range

The project area occurs within the Ryan and Central Summer grazing allotments on the North Kaibab Ranger District with approximately 85 percent of the project falling inside the Ryan Allotment. The Ryan Allotment contains approximately 59,629 acres and is divided into three summer pastures, two winter pastures, and three small holding pastures. It is the three summer pastures (Wildhorse, Warm Springs, and Highway), and the two holding pastures (North and South Burn) that will be affected by the project

activities. The Ryan Summer Pastures are currently authorized for 186 cow/calf pairs for a season of use from April 15 to November 1 in a deferred rotation grazing strategy.

The remaining percentage of the project area falls within the Central Summer Allotment. The project should have little to no effect on the livestock operations in this allotment due to this portion of the allotment being comprised of Forest Service administrative areas, the area surrounding Jacob Lake, State Highways 89A and 67, and other areas where livestock use is discouraged. Likewise, the livestock operations should have no impact to the success of the project.

- **Direct and Indirect Effects**
  - **Action Alternatives 1 and 3**

Given that Alternatives 1 and 3 propose very similar vegetation management activities in the form of mechanical thinning and prescribed burning inside the project area, effects to overall allotment wide understory plant production will be very similar. The thinning of the encroaching conifers will reduce the level of competition for light, moisture, and nutrients with understory species. The prescribed burning will continue to reduce the smaller trees and also the heavy litter content noted in some areas to a more acceptable level.

Comparisons in anticipated actual forage production levels between any of the two action alternatives would be difficult to estimate as specific forage production at each treatment site can be influenced by factors including soil type, slope, and moisture. If adequate annual moisture continues in the years following the treatments, the average understory plant production in the project area can be expected to increase by at least 50 percent with any of the action alternatives. Since Alternative 1 proposes the highest level of tree removal, it is reasonable to assume that this alternative will also provide the greatest gains in understory species production. It would also be reasonable to assume that gains in understory production would be achieved at a lower level in Alternative 3.

The increases understory species production will attribute to better watershed conditions and more available forage to livestock and wildlife. With more forage available for the same annual numbers of livestock, lower utilization rates of understory species and improved vegetative conditions across all of the Ryan Allotment summer pastures can be expected.

To ensure that livestock do not have an adverse effect on the success of the treatments, the livestock operations will be coordinated with the treatment implementation. Currently there are three summer pastures in the Ryan allotment and portions of the project area falls in all three. Implementation treatments will be managed so that intensive activities like prescribed burning will occur in only one pasture at a time. Post-treatment grazing may resume on the pasture when soil and perennial plants, that will likely be grazed, would not be permanently damaged by livestock. The range management definition for this is range readiness. Plants are ready for grazing when at least one of the following characteristics is present: 1) seed heads or flowers, 2) multiple leaves or branches, and/or 3) a root system that does not allow plants to be easily pulled from the ground. These characteristics provide evidence of plant recovery, high vigor and reproductive ability.

By implementing treatment and livestock deferment to one pasture at a time, the livestock permittee will still be able to graze full permitted numbers on the remaining pastures in the allotment. Monitoring of the active and rested pastures will occur to ensure that the planned year to year rotations are not creating excessive utilization to the active pastures and determine when the rested pastures are ready to resume grazing.

- **Alternative 2- No Action**

Under current management the same conditions documented by the Allotment Analysis can be expected to continue. At the present time, the Ryan allotment is appropriately stocked for the average annual forage production. The under-story vegetative conditions inside project area will continue decrease in small increments as grass, forbs, and shrubs are out competed by the encroaching overstory and suppressed by heavy pine needle litter cover. There will be no changes in grazing management outside of the current Allotment Management Plan until the point is reached when available forage is reduced to a level where higher forage utilization percentages occur.

- **Cumulative Effects**

In addition to the effects discussed above, there are cumulative effects that are and could be occurring in the foreseeable future in the Ryan and Central Summer Allotments, which are considered the cumulative effects analysis boundary for this resource.

The JR project in relation to the Ryan Allotment grazing rotations is the planned implementation of the new Ryan Allotment management plan in the near future. Based off the previously mentioned Ryan allotment analysis, the management plan will authorize the development of a new pasture, three new water sources, and modify the annual grazing rotations. These actions are expected to improve cool season grass production, livestock distribution, and increase flexibility for annual pasture rotations. The new Ryan Allotment management plan will make it easier to defer grazing from pastures receiving treatment in the JR project without creating forage utilization problems in remaining pastures. Additional grazing rotation flexibility plus higher understory vegetation production will lead to improved vegetative conditions.

The implementation of noxious and invasive weed control efforts has reduced the number of exotic plant species within the project area. The containment, control, and eradication of species like Musk Thistle, Spotted Knapweed, and Cheatgrass is expected to continue for the foreseeable future. There will be Best Management Practices (PR-27) implemented for the JR project to survey and control existing invasive populations in the project area. With these practices are guidelines for performing project activities that will reduce the risk of introduction of new invasive species and prevent the spread of undetected existing populations.

With plans in effect to defer livestock grazing until restoration treatment areas have recovered combined with an aggressive strategy to control invasive populations, there is little to no anticipated effect to increases in non-native species with livestock grazing. Low grazing pressure on healthier understory species will continue to provide better competition for future non-native invasive species introduced.

3.2.7 Non-native Invasive Species

There are several species of invasive weeds that have been found on the North Kaibab Ranger District. Of these species, Musk Thistle, Spotted Knapweed, and Cheatgrass occur inside the project area along State Highways 89A and 67. Treatment in the form of manual hand grubbing of the thistle and knapweed populations has been ongoing since 2003. Given the taxonomy of these species, that is an effective method of control. Monitoring and removal of found plants is ongoing at each site throughout the growing season each year to ensure newly germinated species are eradicated prior to seed production. Treatment will be ongoing for the foreseeable future. Cheatgrass can be found in many locations across the North Kaibab Ranger District. While most of the larger, denser populations are found in disturbed pinion-juniper woodlands, numerous populations have been found in Ponderosa Pine ecosystems, including along several roads in the project area. Treatments on cheat grass began in the pinion-juniper

woodlands in 2007, prioritizing highest risk locations for treatment. With its abundance across the entire Forest, this species poses the greatest risk of having a negative effect to the project area.

There are other highly invasive species that occur outside of the project area including several thistle and knapweed species and as well Leafy Spurge and other invasives that could still be transported in from other areas of the forest and surrounding lands. These species will be monitored for as the pre-treatment inventory for invasives begins as well as continued monitoring for the duration of the project and beyond.

The North Kaibab Ranger District will continue its non-native invasive species program. Over time, the current known thistle and knapweed populations in the project area will be reduced and/or eradicated. Ongoing monitoring will be performed to find new populations introduced to the Forest with the goal to contain and control appropriately.

- **Direct and Indirect Effects**
  - **Effects Common to All Action Alternatives**

With increased ground disturbance, there is an increased threat of spreading existing infestations. Without early detection and treatment, invasive species like cheatgrass have the ability emerge, reproduce, and rapidly invade into these areas, out-competing the native understory species. Also, there is an increased threat of introducing new species via the vehicles and machinery that come into the project area to perform the restoration activities.

All three action alternatives include the same type of thinning and pre-scribed burning activities across the same total acres, with the difference being the number and size of trees removed and the degree of localized disturbance created the during tree removal. The level of disturbance during tree removal is the determining factor for potential invasive spread. This is a factor that can change from site to site with variables like soil condition, current ground cover, and utilization of existing roads.

  - **Alternative 1—Modified Proposed Action**

The risk of non-native invasive species establishment would continue to increase at current rates or possibly higher. Of the two action alternatives, the Modified Proposed Action calls for the most number of trees removed and related ground disturbing activities. Even though true differences in disturbance from site to site may vary, it could be anticipated that this alternative has highest risk of increasing the spread of invasive species.

  - **Alternative 2- No Action**

Invasive species would continue to be introduced and spread at the current rate. This alternative would provide no direct or indirect impact to invasive species in the project area. There will be a lower level of monitoring activity in the project area, which means new species introduced by animals, wind, and human activities will be less likely to be detected outside of current known and monitored populations.

With no action taken in the project area, there is an increased risk of a high severity fire. Crawford et al. (2001) reported higher cover of cheatgrass on severely burned sites, compared to less severely burned sites, in ponderosa pine in Arizona (ERI, 2007). Comparable results have been found on the North Kaibab Ranger District in the area that burned in the 1996 Bridger Knoll Fire. Unofficial transect readings performed in 2003 on both pinion-juniper and ponderosa pine ecosystems found multiple areas that burned with high intensity were noted for having cheatgrass as the dominant species by frequency. In contrast, areas that burned with light intensity had cheatgrass noted, but at a lower frequency and native species were more abundant.

- **Alternative 3—16 Inch Diameter Cutting Limit:**

The risk of non-native invasive species establishment would continue to increase at current rates or possibly higher. This alternative proposes the second highest amount of trees removed and more ground disturbance of any alternative and creates the second highest risk of invasive species spread.

- **Cumulative Effects**

The project area falls inside two grazing allotments but only impacts to the Ryan Allotment are expected. The proposed restoration treatments will be managed in coordination with the grazing management so that only one pasture receives treatment at a time and can be sufficiently rested afterwards to allow understory vegetative recovery. Allowing the pasture treated to fully recover prior to livestock re-entry will promote new growth of native understory vegetation that can better compete with future invasive weed introductions.

There has been considerable documentation towards how heavy livestock use has lead to increases in aggressive invasive species establishment. There have also been studies that indicate that well managed grazing with low stocking rates can be comparable to not grazing at all. On a seven year study performed in north central Arizona during drought conditions, Loeser et al. (2006) compared exotic species colonization on plots experiencing high impact grazing, moderate intensity, and livestock removal. Their study noted that high impact grazing did show a considerable increase in exotic species, especially cheatgrass, while moderate grazing and complete livestock removal plots experienced very similar results of only small increases in exotic species.

Currently the Ryan Allotment is stocked appropriately for its annual forage production. Given that an anticipated effect of the JR project will be increases in understory growth, re-entry of livestock to areas treated after recovery should not have an adverse effect to continued understory species response. Combining sufficient understory recovery and planned aggressive weed monitoring and treatment, there is no anticipated effect to increases in non-native species once grazing pressure resumes.

There are plans to implement a new Ryan Allotment Management Plan soon. The management plan will authorize the development of a new pasture, three new water sources, and modify the annual grazing rotations. These actions are expected to improve cool season grass production, livestock distribution, and increase flexibility for annual pasture rotations. The new Ryan Allotment management plan will make it easier to defer grazing from pastures receiving treatment in the JR project without creating forage utilization problems in remaining pastures. These grazing management improvements will continue to reduce livestock impacts to the project area, improving the understory species' ability to naturally compete with non-native species.

The planned Travel Management efforts in the near future should assist with improving conditions in the project area. With the intent of disclosing the impacts of cross-country use, camping, and other public use on Forest Service lands, alternatives can be developed to reduce vegetation destruction and the continued spread invasive weeds in the project area. The goal of this effort in relation to non-native invasive species will be to continue to find viable methods of reducing invasive species introduction and spread across NKRD, including the JR Project area.

3.2.8 Heritage

The project area was inventoried for heritage resource sites following the guidelines specified in the *Proposed Survey Strategy for the North Kaibab Ranger District* (Reid and Hanson 2006). Approximately 23,620 acres of the project area were previously surveyed in association with past projects. An additional

1255 acres were surveyed in May of 2008 (Reid 2008). One hundred and thirty-five sites are documented within or immediately adjacent to proposed treatment units.

Documented sites within the area date from the archaic period through the historic period. Prehistoric sites span from the Archaic through the Neo Archaic periods and include camps and rock shelters comprised of artifact scatters, and pueblo habitation sites. Historic sites are most commonly associated logging, mining, with FS administration and 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, a fire lookout, a Navajo brush structure and several collapsed Hogans.

- **Direct and Indirect Effects**
  - **Alternative 1—Modified Proposed Action:**

If the mitigation design criteria (Heritage Resources Specialist Report 2010, PR-28), are met and implemented, then the *Modified Proposed Action* alternative should have no direct or indirect adverse effects to heritage resource sites.

  - **Alternative 2—No Action:**

The *No Action* alternative will not alter the existing condition and will have no direct effect on heritage resources. However, existing fuel loading could have an indirect and cumulative effect on heritage sites in the event of catastrophic wildfire over time, which frequently results in adverse effects to heritage resource sites.

  - **Alternative 3—16 Inch Diameter Cutting Limit:**

If the mitigation design criteria (Heritage Resources Specialist Report 2010, PR-28), are met and implemented, then Alternative 3 should have no direct or indirect adverse effects to heritage resource sites.

- **Cumulative Effects Analysis**

The cumulative effects analysis will be confined to the project vicinity. Project activities will be limited to the project area during the implementation period, and heritage sites are stationary. Actions to protect heritage resources from direct and indirect impacts from project implementation have been described in the above sections. Based on the mitigation design criteria there will be no changes to the physical integrity of heritage resource sites and no cumulative effects within the analysis area.

  - **Action Alternatives 1 & 3**

If the recommended mitigation design criteria measures described in the above sections are employed during project implementation, there will be no cumulative effects to heritage resources from ground disturbing activities or fuels treatments associated with the *Action* alternatives.

  - **No Action Alternative**

There will be no cumulative effects to heritage resources from the *No Action* alternative because no ground disturbing activities associated with salvage, reforestation, or fuel wood treatments will occur within the analysis area. Nor will there be any burning activities that might affect fire sensitive sites.

3.2.9 Scenery and Recreation

- **Alternative 1 – Proposed Action**

Under Alternative 1, the JR vegetation management project, with the design criteria identified in the Scenery and Recreation Report (2010 PR-33) would result in improved scenic quality over time. The

ponderosa pine forest would appear more open; stands would have more groups of trees with spaces between them. Overall tree density would be reduced, and would move toward presettlement conditions (the target landscape characteristic). Grass, forb and shrub growth would increase due to the creation of openings. Since aspen stands are a valued component of the desired condition, further management activities (beyond the scope of this project) would be required to maintain their presence. Old growth would be a visible component of the area. Treated areas would be less vulnerable to crown fires, and reintroduction of fire would help to maintain forest health and make the area more likely to withstand wildfire and insect infestations in the future.

Short-term effects of thinning, slash treatment and management-ignited fire would be apparent during the management activities. These 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, the Modified Proposed Action meets the Forest Plan guidelines or states the deviations from the 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, rather an indication of people being comfortable with what they are familiar with. Daniels (2003) examined human reaction to wildfire hazard, and acknowledges that fuels treatments require immediate public acceptance of changes in their environment in order to protect against an uncertain threat in the future. In addition, there is also an assumption that cutting the forest will produce a less aesthetic, less “natural” landscape. Incremental change is generally more acceptable than drastic changes. Initial reactions to trees being harvested and thinned, ground disturbed, and a freshly burned forest floor will often be negative. Over time as these changes diminish and areas "green up" in the spring, the reactions begin to be more positive. Covington indicated this is the case with restoration treatments that remove many more trees than are proposed in the JR analysis. Overall the scenic effects of the proposal will result in temporary lowering of the visual quality, and increase in visual quality as the proposed management activities are concluded. A return to a more open, group/clump structure will be more positive than a more uniform forest structure. It is anticipated the proposed activities will also bring the scenic integrity to a higher level, where the valued landscape character appears only slightly altered. Noticeable deviations will be lessened, and progress will be made toward the desired condition.

Recreation

- **DIRECT AND INDIRECT EFFECTS**
  - ✓ **ALTERNATIVE 1 – MODIFIED PROPOSED ACTION**

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, hikers may be restricted to established trails, or may be asked to stay out of areas where trees are being felled, or equipment being used. There may also be restrictions for users if prescribed burning is taking place. Off-highway vehicle users would still be able to use existing open roads, but some roads may be closed in the JR area. Cross-country vehicle travel would be restricted only in areas designated in the Forest Plan or future management actions. Special Use permittees, such as Allen's Equestrian would be assured of access to areas for trail rides.

Vegetation treatments and slash treatments would have similar effects as delineated in Alternatives 2 and 3. It is anticipated there would be more trees with charred areas, scorched tree canopies and bark and more tree mortality, as fewer stems will be removed, and fires will generally burn hotter with more fuels. These visual results may be more noticeable and considered unpleasant to forest users. This alternative would need to meet the same general timeframe as stated in Alternatives 2 and 3.

Overall the scenic effects of the proposal will result in temporary lowering of the visual quality. It is anticipated the proposed activities would improve the scenic integrity but the valued landscape character would appears only slightly altered over time as compared with Alternatives 2 and 3. Noticeable deviations will be lessened somewhat, although there will still be abrupt changes in numbers of trees in areas where previous vegetation removal projects have occurred. Progress will be made toward the desired condition for scenic integrity, although at a slower pace than in Alternatives 2 and 3.

✓ **ALTERNATIVE 2 – NO ACTION**

There would be slow changes in the landscape as time passes, changes in scenery would result from natural disturbances rather than planned activities. The forest would continue to have tree densities many times greater than historic conditions. The lack of visual diversity would continue, and the monotony and tunnel-like experience driving along the major highways in the project area, would remain the same. The scenic integrity would continue to be broken up, with abrupt changes due to past management practices, acres of even-aged stands of trees, seed tree cuts where the overstory has been largely removed, few meadows or openings, and few areas of different plant species such as aspen, Gambel oak, shrubby species and forbs. In some instances, the meadows and aspen stands would disappear as the ponderosa pine forest overtakes them. 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 visually unappealing and possibly catastrophic to visitors and nearby permittees and businesses. Following such a large scale disturbance, such as stand replacing fire or large scale insect infestation, the visual quality would be low, 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. There is also a good chance that the facility investments at Jacob Lake would be burned as well.

✓ **ALTERNATIVE 3**

Under Alternative 3, with the design criteria proposed, the project would result in somewhat improved scenic quality over time. The ponderosa pine forest would appear more open, stands would retain high numbers of large diameter trees. These would continue to look like even-aged stands if there is a dominance of trees over 16 inches diameter breast height (DBH). Overall tree density would be reduced, and there would be some movement toward presettlement conditions. Grass, forb and shrub growth would increase due to the creation of openings, but not as much as in Alternative B. Meadow enhancements would stop the encroachment of pines, and create needed visual diversity in the forested lands. Oak clumps and aspen stands would be opened up and competing trees thinned or removed, resulting in more vigorous growth and possibly an increase in the quantity of these species. Old growth areas with trees over 16 inches DBH would not be treated, thus no spacing would be introduced around the trees and they would to be outside the range of variation for the characteristic landscape. Treated areas would be somewhat less vulnerable to crown fires, and somewhat more likely to withstand wildfire and insect infestations in the future. Hazard trees along the highway would continue to be a problem, creating icy conditions in densely shaded areas, and the potential for trees falling into the highway.

➢ **CUMULATIVE EFFECTS**

Timber management, fuels reduction projects, recreation developments, and historic forest management activities in the JR area have resulted in changes to the "natural appearing" landscape and to scenic integrity. The greatest factors have probably been fire suppression and logging practices that changes the characteristic age structure and distribution in the ponderosa pine forest. The development of highways 89A and 67, along with the concentration of services at Jacob Lake has increased the human impacts in

the area. The recreation developments have also resulted in the urban interface situation that makes the proposed management activities in JR critical to reduce fire hazard, even though the project does not specifically treat the wildland-urban interface. Current management activities close by includes the Warm Fire hazard tree removal, along with salvage and commercial fuelwood harvests in the Warm Fire area. These projects will result in short-term changes in the scenic integrity, but it is expected the overall effect will be positive. 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.

Evidence of management activity will be high during vegetation management activities and to a lesser extent during reconstruction at recreation developments. The visual quality experienced along the Highway 67 corridor would be lowered over a longer period of time if other projects are undertaken, for possibly 10 to 15 years, depending upon the timing and areas being treated. The long-term effect of these projects, if they have a similar desired condition, will be to improve scenic integrity. None of these activities would be considered significant effects.

3.2.10 Economics

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**

The Modified Proposed Action would potentially generate about 179,280 CCF of commercial timber. 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 would have considerable 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 Modified Proposed Action would meet the intent of the MOU and the Forest Plan.

- ✓ **ALTERNATIVE 2**

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. The economic cost for suppressing such a fire runs high, usually at $1,000 to $2,500 per acre, posing a potential cost of $26 million for the project area, if such a high intensity wildfire were to occur. 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 or the Forest Plan.

- ✓ **ALTERNATIVE 3**

Alternative 3 would generate approximately 30,614 CCF of commercial timber from thinning trees less than 16 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 Modified 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 JR 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 (USDA Forest Service, 2008b). The economic effects of implementing the JR Project would inject needed workforce dollars into the local economies and when added to other current and foreseeable future projects could have far reaching beneficial effects to multiple county economies for years to come.

3.2.11 Environmental Justice

On February 11, 1994 President Clinton issued Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” requires that Federal agencies make achieving environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high adverse human health and environmental effects of their programs, policies and activities on minority populations and low-income populations. 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.

Neither internal scoping nor public scoping identified disproportionate effects on minority or low-income populations from the proposed action. The Modified Proposed Action does not pose any significant socio-economic risks that disproportionately affect low-income or minority populations in communities where timber producing employment opportunities and workers are located. The implementation of the JR project would not cause a significant change in local employment or revenue sharing with local communities.

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. Due to the fact that the project is located some are is Overall, there would be no shift in risk or potential risk to impacts.

- **DIRECT AND INDIRECT EFFECTS**

  - ✓ **ALTERNATIVE 1 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.

  - ✓ **ALTERNATIVE 2 – NO ACTION**

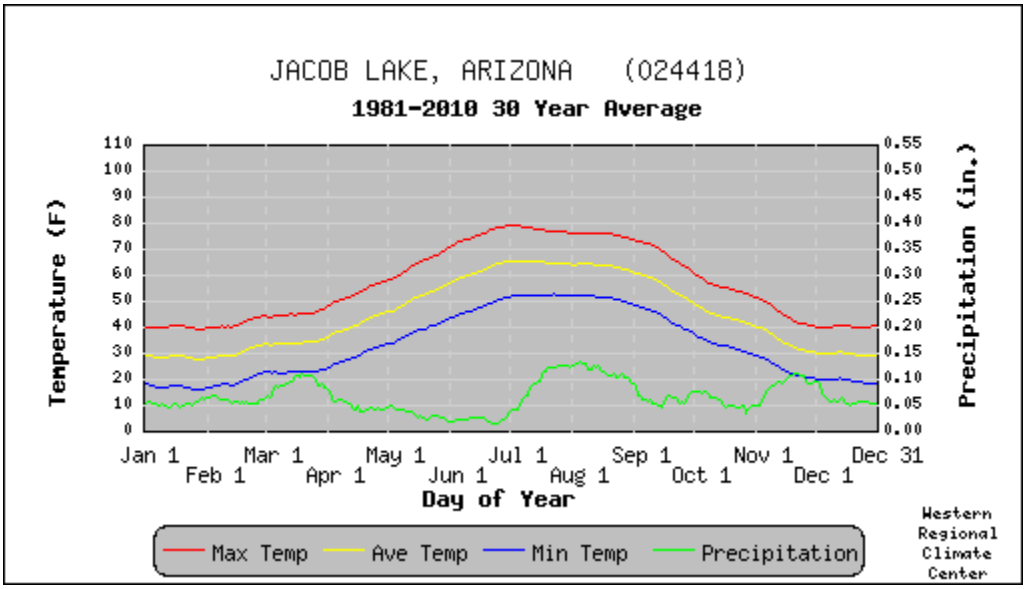
The no action alternative does not reduce the risk of high-intensity, stand-replacing wildfire. Although all communities, wealthy and poor, suffer direct economic consequences when there are large wildfires, normal commercial activity can be disrupted. Many of the low-income jobs in the area are connected 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.

3.2.12 Climate Change Considerations

First, in order to understand or consider climate change, one must understand the definition of climate. According to the Forest Service's "Southwestern Region Climate Change Trends and Forest Planning" document, May – 2010, Climate is defined as follows:

> "Climate may be defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the statistical description of the state or condition of the climate system. In contrast, weather describes the daily conditions (individual storms) or conditions over several days (a week of record-breaking temperatures), to those lasting less than two weeks. Natural climate variability refers to variations due to natural internal processes in the climate system or natural external forcing, in the mean state and other statistics of the climate on all spatial and temporal scales beyond that of individual weather events. Climate and climate variability are determined by the amount of incoming solar radiation, the chemical composition and dynamics of the atmosphere, and the surface characteristics of the Earth."

The National Oceanic Atmospheric Administration (NOAA) website maintains climate and weather data for Jacob Lake, a site within the project area. See http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?az4418 for Jacob Lake – Coop ID #: 024418 weather data for the period from 1916 to 2010; the table below depicts a 30 year average (1981-2010) for annual precipitation at 24.28 inches for Jacob Lake, Arizona.



Addition data 30-year period data is available for from the Western Regional Climate Center (WRCC) (http://www.wrcc.dri.edu/climsum.html). The average precipitation from the WRCC database shows that the Jacob Lake area location is 23.10 inches for the years 1971-2000, and 21.66 inches for years 1961-1990. The average annual minimum and maximum temperatures for these same time periods indicates a trend of a 1.0 degree increase in minimum annual temperate and a 0.4 degree decrease in the average annual maximum temperatures. 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 has received average or above average precipitation over the last 9 years. 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 design criteria.

One of the predictions about climate change is that wildfires would become larger and more frequent at the landscape scale (Backer et al. 2004). The potential for climate change makes it more important to implement treatments like Jacob-Ryan, especially given that cheatgrass (Fire & Fuels, page 63) is of particular concern following high intensity fire events. 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, thereby protecting wildlife habitat.

Thinning to the desired number of trees per acre by VSS class would help minimize the effects of drought. Stone et al. (1999) found that thinning to restore pre-Euro-American stand structure improves the vigor of large ponderosa pines. Improved tree vigor was indicated and measured by increased canopy growth along with the uptake of water, nitrogen, and carbon. Vigor increases resistance while densely stocked trees are highly susceptible to insects and disease (Larsson et al. 1983). These results suggest that appropriate forest management can be used to maintain the ponderosa pine forests of the Southwest. Vegetation management prescriptions would use best management practices, design criteria, mitigation measures, and monitoring to implement proposed treatments on the ground.

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. Such big, fast changes in Southwest forest vegetation could have significant effects on a wide range of ecosystem goods and services, from watershed protection and timber supplies to biodiversity and recreation. These emerging vulnerabilities present increasingly clear challenges for managers of southwestern forests to develop strategies to mitigate or adapt to the coming changes, in order to sustain these forested ecosystems and their benefits into the future (MLA University of California, 2010).

Projects like JR 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 competition between trees 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.

None of the alternatives affect climate change to any measurable level. The no action alternative has the highest potential to release carbon in a relatively large quantity over a short period of time due to the increased risk of a stand-replacing wildfire occurrence. Carbon will still continue to be stored under the no action alternative but at a slower rate than the action alternatives. The Modified Proposed Action will increase tree growth the most of all alternatives and will sequester the most carbon of the alternatives creating a forest that would be the most resilient to climate change because it will have the lowest density of trees. Alternative 3 will create a more resilient forest than the no action alternative.

3.3 Effects Relative to Significance Intensity Factors

(1) Beneficial and adverse impacts.

In this analysis, beneficial effects were not used to offset otherwise potentially significant effects. For example, long term benefits were not used to offset any potentially significant short term effects. Any potentially adverse effects of thinning and prescribed burning as proposed in this project would be short term and minor in nature and would not impair land productivity.

One example of this is how this analysis addressed effects on canopy cover. The short term effect of thinning and prescribed burning is to reduce canopy cover. But if such reductions are limited by design features in the proposal, the long term effects are that canopy cover would likely re-grow to current levels within 20 years after treatment. Having design features to limit short term reductions in canopy cover prevents those effects from being significant in their own right.

There are very dense stands in the JR project area, especially nest areas that need thinning from below to improve fire-resistance and protection from stand-replacing, crown fires. Though we cannot replace lost habitat and forested acres in the nearby Warm Fire in the short-term, we can implement thinning treatments in JR to reduce the hazard of stand-replacing crown fire.

The even-aged stands in JR compose a large part of the project area. This first entry is designed to move these stands toward uneven-aged condition, to improve forest health with thinning and prescribed fire, and maintain a fire-adapted system resilient to the effects of wildfire, insects and disease, and the potential effects from climate change. Our analysis indicates there would be short term surpluses in acres of VSS 2-3, and short term deficiencies in acres of VSS 1. Over time, proposed treatments in this and subsequent projects would gradually reduce surpluses and deficits as stands grow and are thinned and prescribed burned. Gradual progress toward the desired VSS distribution under the Forest Plan helps maintain old forest, yet regenerate enough young forest to eventually take its place as VSS 5 – 6 as trees grow from VSS 3 and 4 into VSS 5 and 6.

Canopy cover guidelines apply to mid-aged through old forest categories (VSS 4 - 6). In the Jacob-Ryan FAs, we would manage for about 40+% in VSS 4, 40+% in VSS 5, and 40+% in VSS 6 (KNF Forest Plan, 1987 as amended). See the Vegetation Resource Specialist Report (2011, PR74), for simulations in Foraging Areas with full implementation of vegetation management standards and guidelines of the Forest Plan for the northern goshawk S &G's. The Foraging Areas would be more open after the Modified Proposed Action, as is evident by the basal area ~ 70 square feet per acre, but would still have crown connectivity in the groups. Canopy cover at the group level would be maintained with the Modified Proposed Action in PFAs following Forest Plan guidelines. In Nest Stands, with thinning from below up to 12 inches DBH primarily, crown connectivity would also be maintained.

(2) The degree to which the Modified Proposed Action affects public health or safety.

There will be no significant effects on public health and safety. There are no known adverse impacts to public safety (Recreation Specialist Report 2010, PR33). Some roads may be temporarily closed during project implementation as a public safety measure. Projects that have been considered in the cumulative analysis were initiated to increase public health and safety. The ADOT and Forest Service hazard tree removal projects along Highways 67 and 89A and along FS secondary roads removed burned trees as a result of the Warm Fire that were potentially hazardous to vehicular traffic. These projects have increased public safety along the public highways and forest roads.

The Plateau Facility Fire Protection Project is designed to provide fire protection for sites and facilities to help protect life and property and increase public safety. Of the total acres to be treated, about 900 acres fall within the boundaries of the Jacob-Ryan and another 2,000 acres fall within the ad-hoc analysis area.

(3) Unique characteristics of the geographic area.

There will be no adverse effects on unique characteristics of the geographic area. Ecologically critical areas such as park lands, prime farmlands, wetlands, wild and scenic rivers, etc. do not exist in the project area. One hundred and thirty-five cultural resources (sites) are documented within or immediately adjacent to proposed treatment units (Heritage Resources Specialist Report 2010, PR28). 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). 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. Project 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 and comply with best management practices (USDA NKRD, 2010-PR27). The Heritage Resources Specialist Report and Best Management Practices report are hereby incorporated by reference and are available on request from the project leader.

(4) The degree to which the effects on the human environment are likely to be highly controversial.

Some disagreements exist with certain aspects of the project and were brought up during the scoping period. The Scoping Comment Summary addresses each of those disagreements; that report is hereby incorporated by reference and available on request from the project leader.

One disagreement brought up during Scoping is that trees 16 inches in diameter and larger are extremely rare in ponderosa pine forest at a landscape scale, in Arizona and New Mexico, and the

Modified Proposed Action would reduce their numbers further. Historical data on numbers of trees in different size classes across inventory periods spanning the last 100 years shows that trees 16 inches in diameter are more numerous now than in 1910, in ponderosa pine forests in AZ and NM. The same is true of trees with larger diameters up to 30 inches, except for a slight decrease in trees between 23 to 25 inches in diameter. In an uneven aged forest, larger trees will always be less abundant than smaller trees. Inventory data (Common Stand Exams, NKRD records) show that trees 16 inches and larger (up to 30 inches) are not rare compared to historical conditions (Lang and Stewart 1910).

Another disagreement brought up during scoping is that the North Kaibab Ranger District is deficient in mature forest structure (VSS 5 and 6), and that this project would reduce that further. However our analysis indicates that Geographic Area 13 (GA 13, about 270,000 acres) currently has 24% ponderosa pine old growth, thus meeting Forest Plan management direction. In addition, at the project level, the analysis showed that nest areas (which are thinned from below up to only 12-inches DBH) compose 80% of the old growth within the project area, and that overall percentage of old growth (across the landscape) within the JR project area would be 21% within the ponderosa pine type forest.

Another disagreement raised during Scoping, and possibly more relevant to effects, is that this project will cause effects cumulative with the Warm Fire suppression event. Both the Scoping Comment Summary previously incorporated by reference and the Scales of Analysis section near the beginning of this chapter address this contention, pointing out that the vegetation type, elevation and seed zones of the Warm Fire suppression area differ from the JR project area. That is why a reasonable analysis area for the cumulative effects of this project on vegetation and fuels does not include or overlap with the Warm Fire suppression area.

All comments received during scoping were considered in the Scoping Comment Summary (2010, PR-26), and no scientific or factual evidence has been uncovered to indicate that the environmental effects of this project as proposed would be different from the effects analyzed and disclosed in this EA.

(5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

The effects analysis shows the effects are not uncertain, and do not involve unique or unknown risk. The actions described in this decision have been used before. The Forest Service has a long history of implementing these activities on the Kaibab National Forest. We have used accepted models to help predict and achieve the desired outcome. These actions have been applied elsewhere on similar soil and vegetation types.

Two recent projects on the North Kaibab include Fracas and Dry Park. Fracas was a wildlife habitat improvement project which included thinning 772 acres of uneven-aged stands and 841 acres of even-aged stands followed by prescribed burning. The basal area before thinning was 118, with about 480 trees per acre, after treatment the basal area ranged from 90-100, with 200-210 trees per acre, accomplishing the objective to reduce tree density and improve growing conditions for residual trees.

Dry Park was in mixed conifer habitat. The basal area before treatment was 113 with over 700 trees per acre and 970 aspen trees per acre. After the project implementation, thinning and recent prescribed burning, we targeted ~200 trees per acre in mixed conifer, and retained all aspen; accomplishing the major objective of reducing tree density in mixed conifer and promoting a fire-resistant stand.

The North Kaibab also has experience implementing thousands of acres Shelterwood Seed Step treatments in the mid-to-late 1980s. Those treatments are analogous to thinning from below, except that far fewer trees per acre are left after Shelterwood Seed Steps than after thinning treatments such as those proposed for JR. But in both cases, "leave unit trees" have to be selected and designated in such a way that target stocking levels are achieved at the end of both mechanical and prescribed fire treatments. Experience gained with successful SW Seed Step treatments in the 1980s is relevant and applicable to planning and implementing current projects with proposed thinning and prescribed burning treatments, like JR.

(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

The action is not likely to establish a precedent for future actions with significant effects, nor does this represent a decision in principle about a future consideration. A decision to implement this project does not establish any future precedent for other actions within or outside of the project area.

During scoping it was suggested that the project include removal of encroaching conifers in meadow and aspen habitat. But the Scoping Comment Summary (previously incorporated by reference) points out that the current project area as shown on maps in the Scoping letter does not include any relic meadows or aspen habitat. A project to address relic meadows and aspen habitat in areas outside of but near this project may be considered in the future, but would probably be in response to a purpose and need somewhat different from the purpose and need for this project. Future actions outside of but near this project will be evaluated through the NEPA process and will stand on their own merits as to environmental effects and feasibility.

(7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts.

The cumulative impacts of this project would not be significant. Proposed treatments are not related to other actions that, when combined, will have significant impacts.

The JR project has design elements that will minimize on-site impacts to soil and water resources. With implementation and monitoring of BMPs and strict adherence to timber sale contract provisions, and given the existing condition of the proposed project’s soil and water resources, implementation of the project will result in no detectable cumulative effect on the status of water quality and soil condition within the spatial and temporal scales identified in this analysis (Soil and Watershed Specialist Report, 2011).

Cumulative effects to air quality are monitored and controlled through Arizona Department of Environmental Quality (ADEQ) regulations (Fuels Specialist Report, 2011).

Based on the mitigation design criteria there will be no changes to the physical integrity of heritage resource sites and no cumulative effects within the analysis area (Heritage Resources Specialist Report 2010-PR).

Based on mitigation measures, including seasonal restrictions, effects to wildlife habitat are expected to be minor and short-term are not likely to cause significant effects when considered with other activities in the general area (Biological Evaluation Specialist Report, 2011).

(8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, or may cause loss or destruction of significant scientific, cultural, or historical resources.

The Modified Proposed Action or the other action alternative (Alternative 3) will have no adverse effect on National Register-eligible districts, highways, or structures, because none of these features occur within the project area. This project would not cause loss or destruction of significant scientific, cultural, or historical resources, because the project area has been surveyed and all the cultural resource sites that were found will be avoided during implementation of this project; and furthermore, contract provisions also require protection of any sites discovered during implementation. This project will increase protection from the threats of wildfire through fuel reduction in or around eligible historic properties. Potential archeological, cultural, and historic sites were inventoried within the JR project area in 2008; State Historic Preservation Office clearance was received on June 30, 2008. Project implementation and project area specific requirements are addressed in the Heritage Resources Specialist Report (2011). This report identifies site eligibility, survey coverage, site types, fire tolerant and intolerant sites, and other information specific to those surveys. All fire intolerant sites will be avoided and protected. No ground disturbing activities will be allowed within any eligible archaeological properties. Fire tolerant sites are identified in the report which describes the conditions and mitigations required before treatment. This report is incorporated by reference and available on request from the project leader.

(9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

Other than the California condor (an Endangered Species), which was re-introduced as an experimental population in northern Arizona (EA. pp. 81 & 110), there are no other Threatened and/or Endangered (T&E) species present in the project area. Region 3 Forest Service sensitive species are analyzed under the Biological Evaluation (BE) Specialist Report and EA. Conservation measures for the California condor have been incorporated into the EA (Appendix C-1). Possible effects to federally listed wildlife species were analyzed in the Biological Evaluation Specialist Report (2010-PR31). The action will not adversely affect any T&E species or habitat that has been determined to be critical under the Endangered Species act of 1973 (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq. , ESA).

(10) Whether the action threatens a violation of Federal, State, or local law or other requirements imposed for the protection of the environment.

The Modified Proposed Action will not violate Federal, State, and local laws or requirements for the protection of the environment. Applicable laws and regulations were considered and can be found in the various JR Project Specialist Reports. The action is consistent with the Kaibab National Forest Land and Resource Management Plan and the National Forest Management Act.

During the interdisciplinary analysis and evaluation, resource specialist referenced laws, rule, and regulations, executive orders, as applicable. These laws included, but were not limited to the following:

National Forest Management Act of 1976: The National forest Management Act requires the Secretary of Agriculture to specify "guidelines for land management plans developed to achieve the goals of the Program, which provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-used objectives" [16 USC1604 (g) (3) (B)]. All alternatives were developed in compliance with NFMA and the Kaibab Land and Resource Management Plan, (1988) as amended. The Forest Plan contains guidance for the design of vegetation treatments to improve habitats for management indicator

species (MIS), including provisions for diversity, old-growth, habitat components (i.e. snags and logs), and a range of vegetation successional stages. The Wildlife Specialist Report and Chapter 3 of this EA evaluate the effects to MIS in light of current research, habitat availability, and existing population data (Section 3.2.4.3 "Management Indicator Species," EA pp. 92-95).

National Environmental Policy Act of 1969: The Forest Service procedures for implementing NEPA are codified in 36 CFR, part 220. These establish procedural and content requirements for environmental analysis and documentation of Forest Service proposals. This EA for the Jacob-Ryan project was prepared in full compliance with NEPA and related, applicable regulations.

Federal Water Pollution Control Act 1977 (Clean Water Act): Alternative 1 conforms to the Clean Water Act as amended (1982). This act establishes a non-degradation policy for all federally proposed projects. Through the use of best management practices, Alternative 1 meets the standards agreed to in an MOU between the State of Arizona and U.S. Department of Agriculture Forest Service Southwestern Region (1990). Additionally, the project is distant enough from 303(d) listed water bodies to not affect any listed streams. Executive Orders 11990 (Wetlands Management) and 11998 (Floodplain Management) would be met as there are no affected flood plains or wetlands within or directly adjacent to the project area.

ADEQ's Draft 2006 biennial report provides information on the status of water quality. The Soil and Watershed Specialist Report (2011) meets the reporting requirements under the federal Clean Water Act sections 305 (b) (assessments), 303 (d) (impaired waters list), 106 (monitoring), 204 (grants), 319 (nonpoint source), and 314 (lakes program) (Marsh and others, 2006). The Report summarizes the status for water quality in Kanab Creek. The status of water quality for Marble Canyon portion of the Colorado River was not reported in ADEQ's Draft 2006/2008 biennial report. Kanab Creek and the Marble Canyon portion of the Colorado River were not identified on Arizona's 2006/2008 list of 303(d) Impaired Waters.

The Endangered Species Act of 1973 as amended (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq., ESA)**:** There are no Threatened and/or Endangered (T&E) species present in the project area. Possible effects to federally listed wildlife species were analyzed in the Biological Evaluation Specialist Report (2010-PR31). The action will not adversely affect any T&E species or habitat that has been determined to be critical under the ESA. Also refer to bullet number 9 – titled "Threatened, Endangered, and Sensitive Species," under "Intensity" above.

Migratory Bird Treaty Act: Executive Order 13186 was enacted to ensure federal agencies protect migratory birds through project design that limits adverse impacts to migratory bird resources and assures that migratory bird species receive consideration in the decision-making process. Executive Order 13186 also tasks federal agencies to identify unintentional take of migratory bird species during land management actions. Four species in the project area have been identified: northern goshawks, olive sided flycatchers, Cordilleran flycatchers, and purple martins. The northern goshawk is considered in detail in the sensitive species report of the EA (Section 3.2.4.4 "Migratory Birds," EA pp. 96-97). Effects to olive sided flycatchers, Cordilleran flycatchers, and purple martins are considered minor short term effects, and would not result in a measurable negative effect to bird populations (EA, p. 97). The same section of the EA discloses that other potential effects to migratory bird populations are expected to be low to non-existent, dependent upon the timing of project activities with nesting seasons.

Grand Canyon Game Preserve: The Jacob-Ryan project is located within the Grand Canyon Game Preserve, which was established by proclamation by President Theodore Roosevelt on November 28, 1906 to protect game species and their habitat. The Kaibab 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 and continue to provide breeding places for those species (see EA, p. 97; Section 3.2.4.5 "Specially Designated Areas).

Kaibab Squirrel National Natural Landmark (NNL): In 1965, 278,459 acres of ponderosa pine forest within the Kaibab National Forest and Grand Canyon National Park were designated as the Kaibab Squirrel National Natural Landmark (NNL). NNLs are designated by the Secretary of Interior and represent unique examples of ecological and geological features that comprise our nation's natural history. The NNL designation is not a land withdrawal and does not direct or prohibit any activity. The Forest Service and the U.S. Department of Interior - National Park Service agree that activities in the Jacob-Ryan Project are designed to have little or no negative effect to significant NNL resources, nor is the project in opposition to the purpose of NNL designation. But that the resources of the Kaibab Squirrel Area NNL have the potential to benefit from management activities proposed to improve the overall forest conditions. (EA, Section 3.2.4.5 "Specially Designated Areas," EA, p 96). Additionally, the NKRD is actively involved with the NNL program on the district regarding status of the squirrel habitat, current management, and effects of wildfire within the Kaibab Squirrel NNL area, which is to the benefit of the Kaibab Squirrel.

National Historic Preservation Act of 1966, as amended: Section 106 requirements for survey and evaluation have been met for all undertakings listed under this proposed action. Also refer to bullet number 8 – titled "Sites or Properties on or eligible for the National Register of Historic Places," under "Intensity" above.

Clean Air Act of 1970 as amended: Protect and enhance air quality while ensuring the protection of public health and welfare. Alternative 1 is designed to meet the National Ambient Air Quality standards through avoidance of practices that degrade air quality below health and visibility standards. Burning would be done only after receiving approval from the Arizona Department of Environmental Quality (ADEQ) that burning can proceed. ADEQ is the regulatory agency for air quality (including smoke) in Arizona.

Any prescribed burning will be conducted only with approved site specific burn plans with standard smoke management mitigation and approvals. Burning would be conducted in favorable atmospheric conditions so as to minimize effects from smoke to nearby communities and recreationist. All burning will be conducted according to Arizona Department of Environmental Quality Regulations. These regulations ensure that effects from all burning within the area are mitigated and that Clean Air Act requirements are met.

CHAPTER 4 – COORDINATION AND CONSULTATION

4.1 Inter-Disciplinary Team (IDT) Members

Core interdisciplinary team members

David Vincelette, NEPA Planner

G.T. Allison, NEPA Coordinator (retired)

Garry Domis, Silviculturist

Jeff Hink, Soils and Watershed

David Robinson, Fire and Fuels

Angela Gatto, Wildlife

Connie Reid, Heritage

Dustin Burger, Range

Kevin Larkin, Recreation (former specialist)

Extended interdisciplinary team members

Alvin Brown, Environmental Coordinator (retired)

Kelly Fike, NEPA Advisor

Bruce Higgins, Planner

Paul Callaway, Forester

Kit MacDonald, Soil Scientist

Wade Christy, Recreation

The Forest Service consulted the following individuals, Federal, state and local agencies, tribes and non-Forest Service persons during the development of this environmental assessment:

4.2 Federal and State Officials and Agencies

U.S. Fish and Wildlife Service, Flagstaff, Arizona

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

Arizona Department of Environmental Quality

State Historic Preservation Office (SHPO) and the Advisory Council on Historic Places (ACHP)

National Natural Landmark (NNLs) for the Kaibab Squirrel

4.3 Businesses and Special Interest Groups

Grand Canyon Trust, Flagstaff, Arizona

Vermillion Services, Kanab, Utah

Center for Biological Diversity, Albuquerque, New Mexico

Sierra Club, Flagstaff, Arizona

Grand Canyon Wildlands Council, Flagstaff, Arizona

Arizona Greenworks, Flagstaff, Arizona

Ecological Restoration Institute, Flagstaff, Arizona

Dave and Don Johnson, Ryan Allotment Permittees, Fredonia, Arizona

4.4 Tribes

Kaibab Band of Paiute Indians

Navajo Nation

Hopi Tribe

4.5 Tribal Consultation Summary

The Jacob-Ryan Vegetation Management Project was added to the Kaibab National Forest Schedule of Proposed Actions (SOPA) during the Second Quarter of Fiscal Year 2007. On January 24, 2007, the Kaibab National Forest initiated government-to-government consultation by sending a consultation letter and an updated copy of the SOPA to the Havasupai Tribe, the Hopi Tribe, the Hualapai Tribe, the Kaibab Band of Paiute Indians, the Navajo Nation, the Yavapai-Prescott Indian Tribe and the Pueblo of Zuni. On January 24, 2007, the Forest initiated public scoping of tribal communities by sending a copy of the SOPA to the 72 Bodaway/Gap, Cameron, Coalmine, Coppermine, Lechee, Leupp and To'Nanees'Dizi Chapters of the Western Navajo Agency.

The National Historic Preservation Act (NHPA), the American Indian Religious Freedom Act (AIRFA), as well as various other laws and regulations require that agencies consult with culturally affiliated tribes to determine the effects of the projects 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 other resources of concern within the project area as per memoranda of agreement between the Forest Service and the Tribes. The Navajo Agency of the Navajo Nation was also consulted (February 14 and May 22, 2008). All tribes supported the implementation of recommended site avoidance measures. No other issues were raised. The Tribes were consulted again in 2010 regarding the new scoping and proposed action, concerning the modifications to the original alternatives, as part of annual consultations between the Kaibab National Forest and each tribal government. No new issues or concerns were brought forward. Copies of the SOPA including updated information about the project have been mailed to the above tribes on a quarterly basis since that time.

CHAPTER 5 – REFERENCES

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APPENDIX A – SVS PICTURES

Stand 1640003

The following pictures (Figures A-1 thru A-3) show the Modified Proposed Action in the even-aged stratum for Stand 164003 at the beginning of a controlled burn, after fire, and at the end of the simulation period. This stand responded well to both thinning from below, and controlled fire under moderate conditions of moisture, temperature, and wind speed. The stand has a small component of aspen that was stimulated by the ground fire, and populated part of the stand with fire resistant trees. Thinning from below created enough openings to allow fire to play a role, and leave overstory trees in a healthy condition. Understory ponderosa pine trees also survived the ground fire, and would provide areas of successful regeneration for future needs.

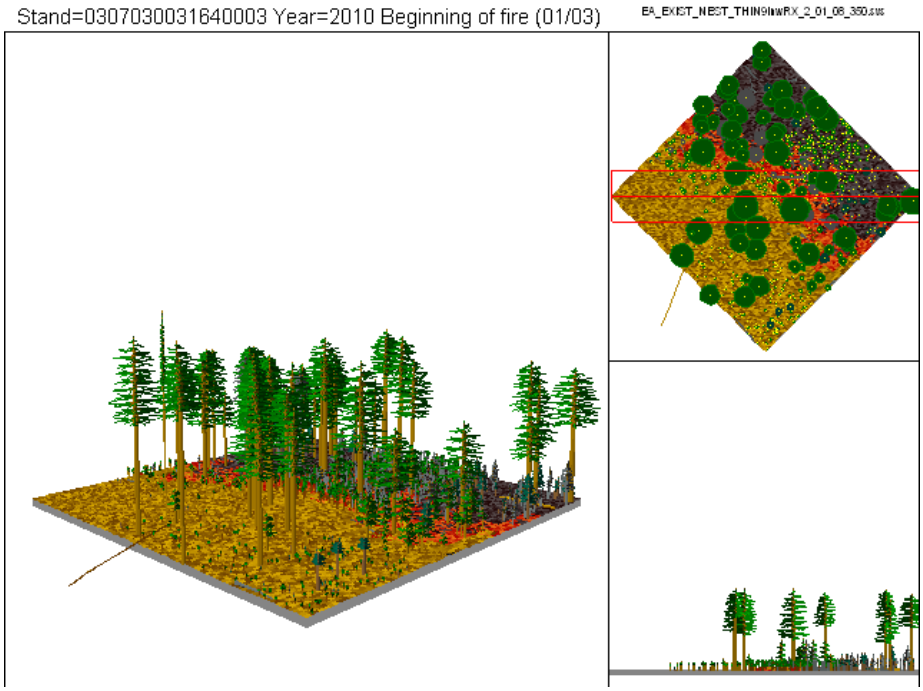

Figure A-1.
Stand 1640003 at the beginning of a prescribed fire in year zero (0), post thinning from below.

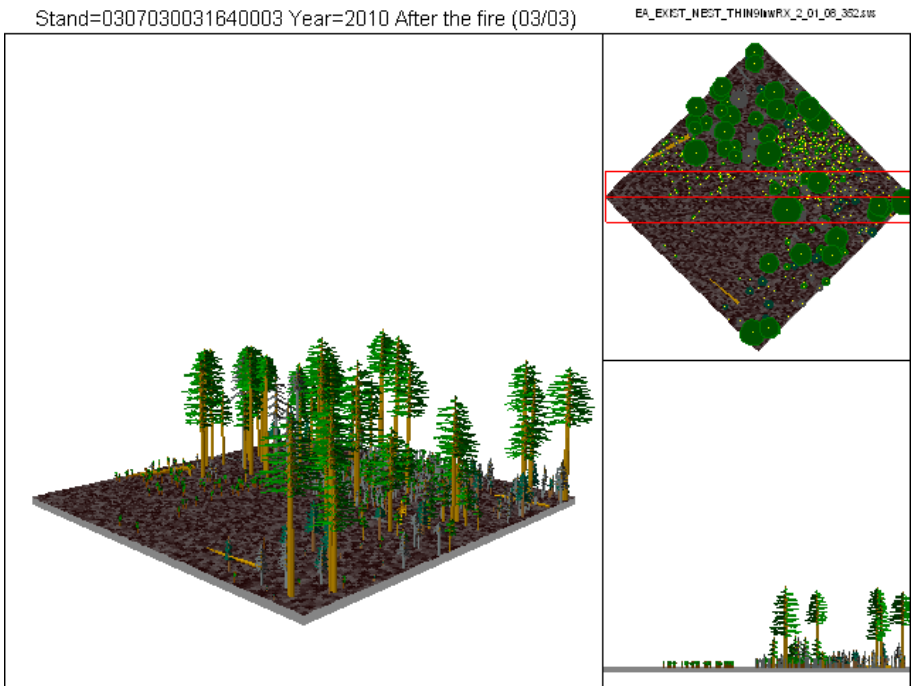

Figure A-2.
Stand 1640003 immediately after a prescribed fire in year 2010.

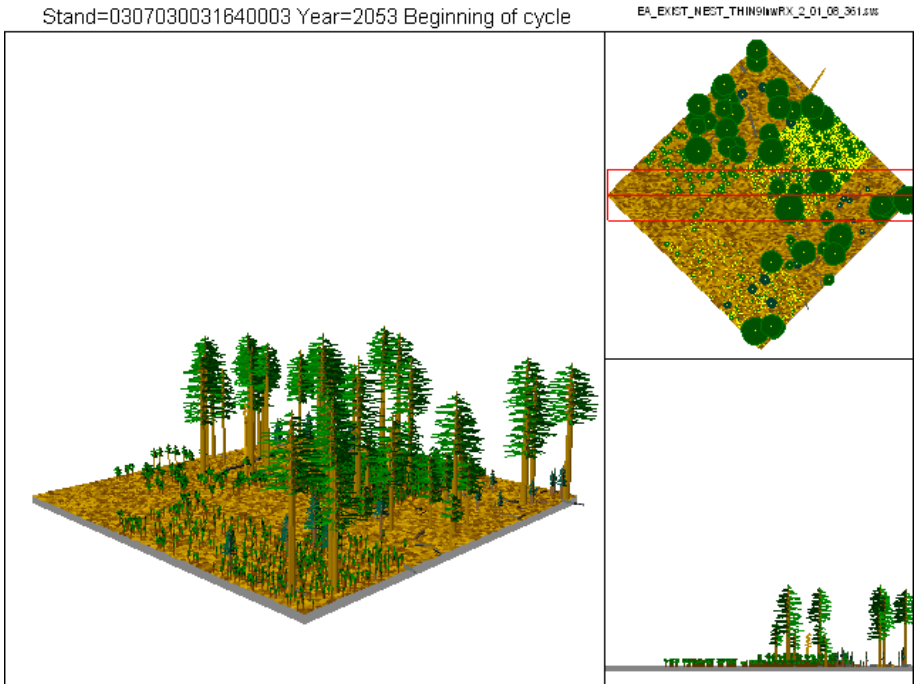

Figure A-3.
Stand 1640003 at the end of the simulation period.

Stand 0550118

The No Action alternative could also result in type conversion of some stands in the Existing Nest areas. See Figure A-4 through A-6 for a visualization of Stand 0550118. The simulated wildfire was modeled under 90th percentile fire conditions derived from historic fire data on the NKRD (J. Erickson, AFMO/Fuels Specialist).

There is no way to predict where or when a wildfire may occur on the NKRD, but recent experience with the Warm Fire (2006) does prove that under dry conditions, in densely stocked stands with low humidity, high temperatures and strong winds, stand-replacing crown fires do occur. The following SVS pictures predict stand conditions in Site 0550118 ***if*** a wildfire were to happen.

The Following three pictures (Figures A-4 through A-6) show stand conditions before the fire, immediately after the fire in 2014, and at the end of the period in 2055.

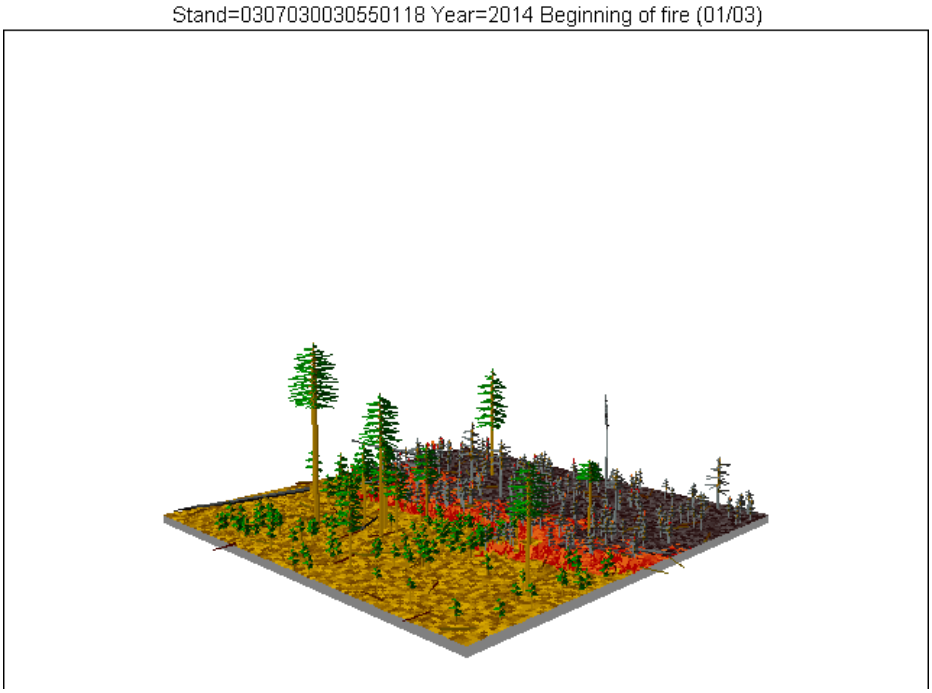

Figure A-4.
A Projection of an existing nest stand in year 2014 under the No Action alternative, at the beginning of a simulated wildfire.

Figure A-5. Simulation of Stand 0550118 immediately after a wildfire in year 2014 under the No Action alternative

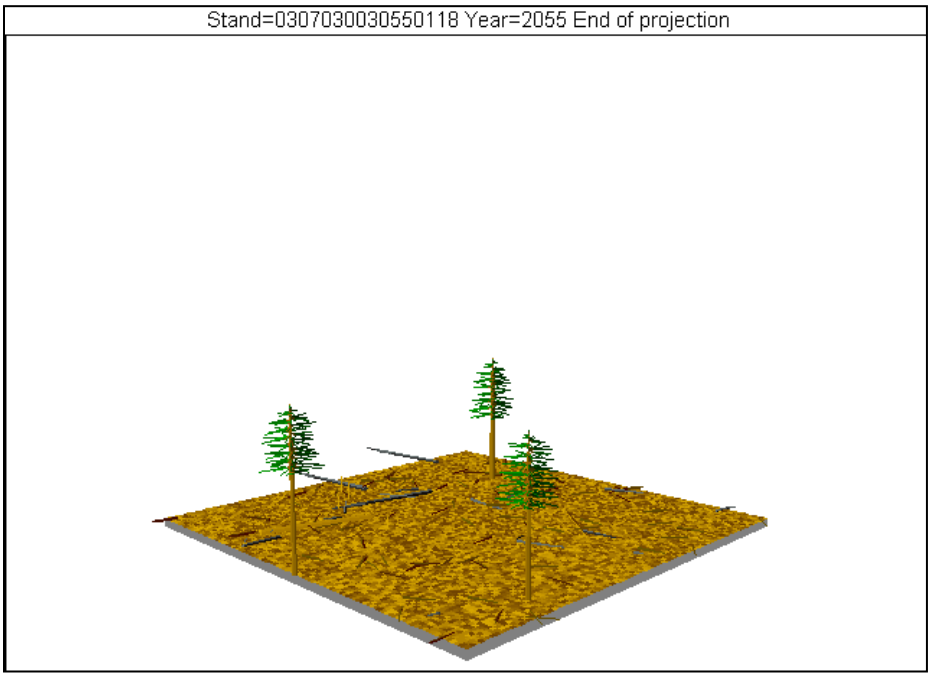

Figure A-6. Stand 0550118 after a wildfire in year 2053; basically grassland with scattered ponderosa pine trees.

The remarkable aspect of these three simulations is the destructive nature of the fire in a relatively open stand. Type conversion is a risk if stand replacing wildfire occurs at 90th percentile conditions. Though 90% of the days during the fire season have less extreme fire weather, there is certainly a risk of destructive wildfire in some even-aged stands.

Stand 0540011

The following three pictures (Figures A-7 thru A-9) reveal the current condition of dense tree stocking, and the risk of destructive wildfire with No Action. These stands would decline from a forest health perspective, and would deviate further from the desired condition of fire-adapted systems. The Basal Area ranges from 130 – 170; very dense stocking in ponderosa pine. SDI soars to 350 at the end of the modeling period.

The JR nest stands provide critical habitat for the goshawk, and the important features of old forest, large trees, and uneven-aged, multi-storied structure need to be sustained. The effects of wildfire would be destructive to Stand 0540011 in the long-term, and may require many decades to return to pre-fire conditions. Parts of the stand may convert to grassland if there is no mechanism or treatment to establish ponderosa pine regeneration. There is a minimal component of aspen, but the preferred species for goshawk habitat on the NKRD is ponderosa pine. The three following SVS pictures (Figures A-7 thru A-9) represent the effects *if* a wildfire would occur in Stand 0540011 given existing stand conditions.

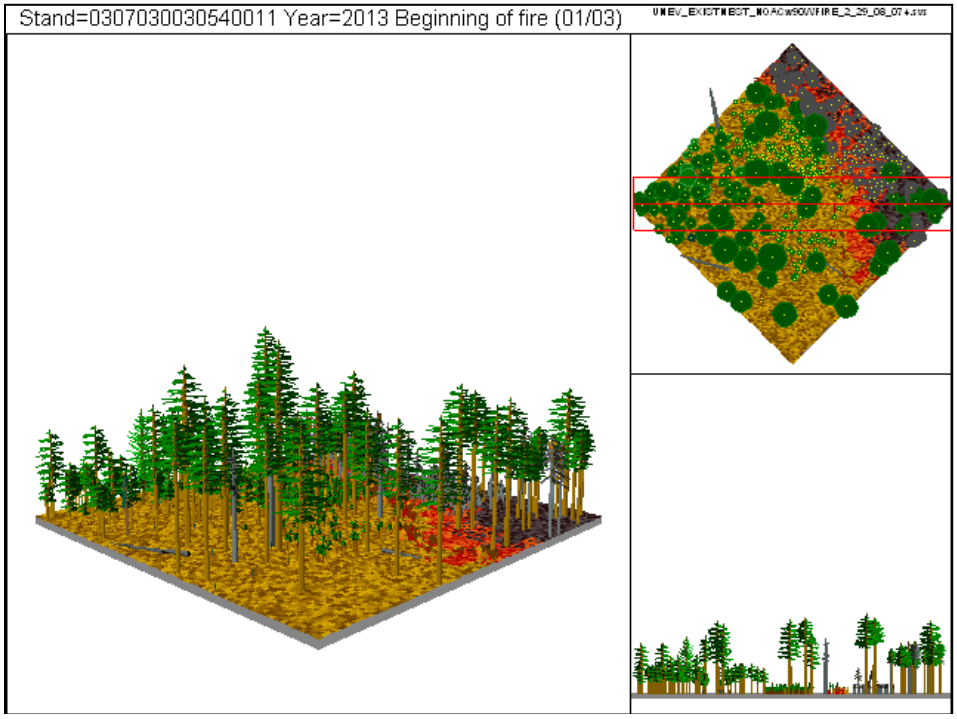

Figure A-7.
Stand 0540011, a large existing nest stand, at the beginning of a simulated wildfire in 2013.

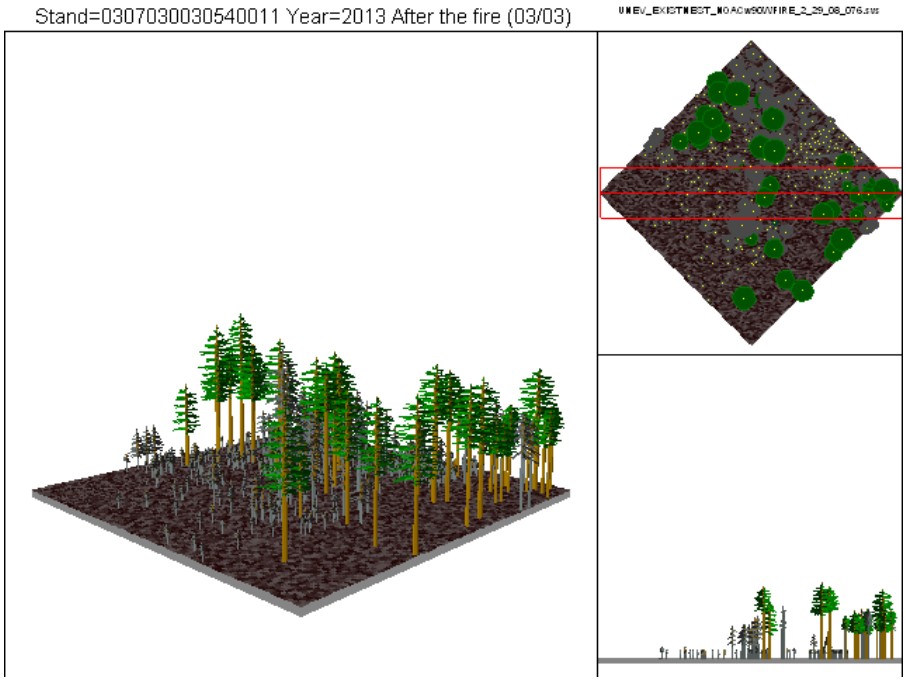

Figure A-8.
Stand 0540011 after a simulated wildfire in 2013 with heavy mortality in young trees.

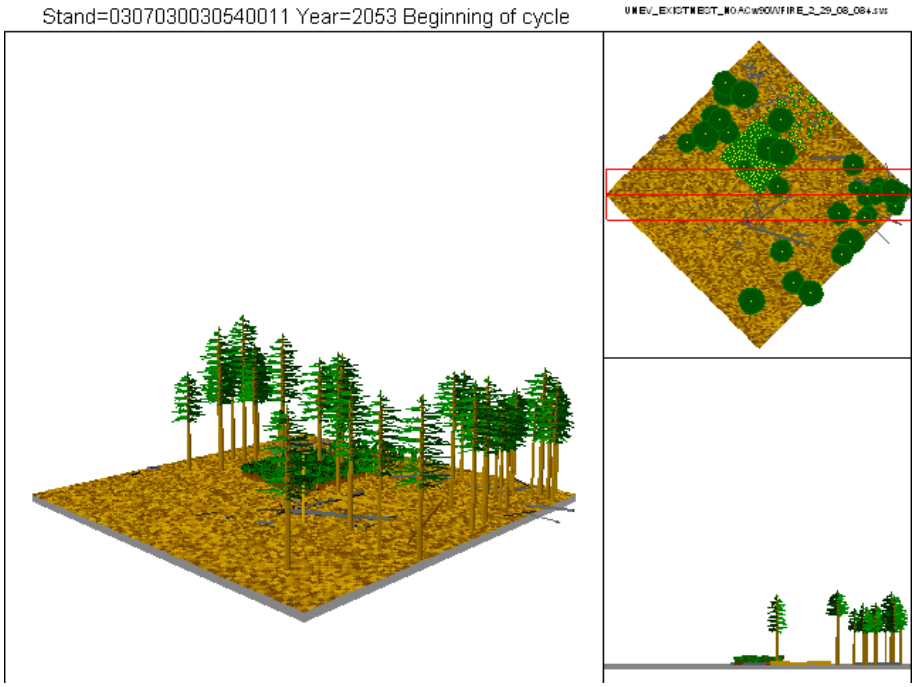

Figure A-9.
Stand 0540011 end of period with low stocking, some aspen sprouts (light green), and minimal ponderosa pine regeneration.

APPENDIX B – FLAMMAP OUTPUTS

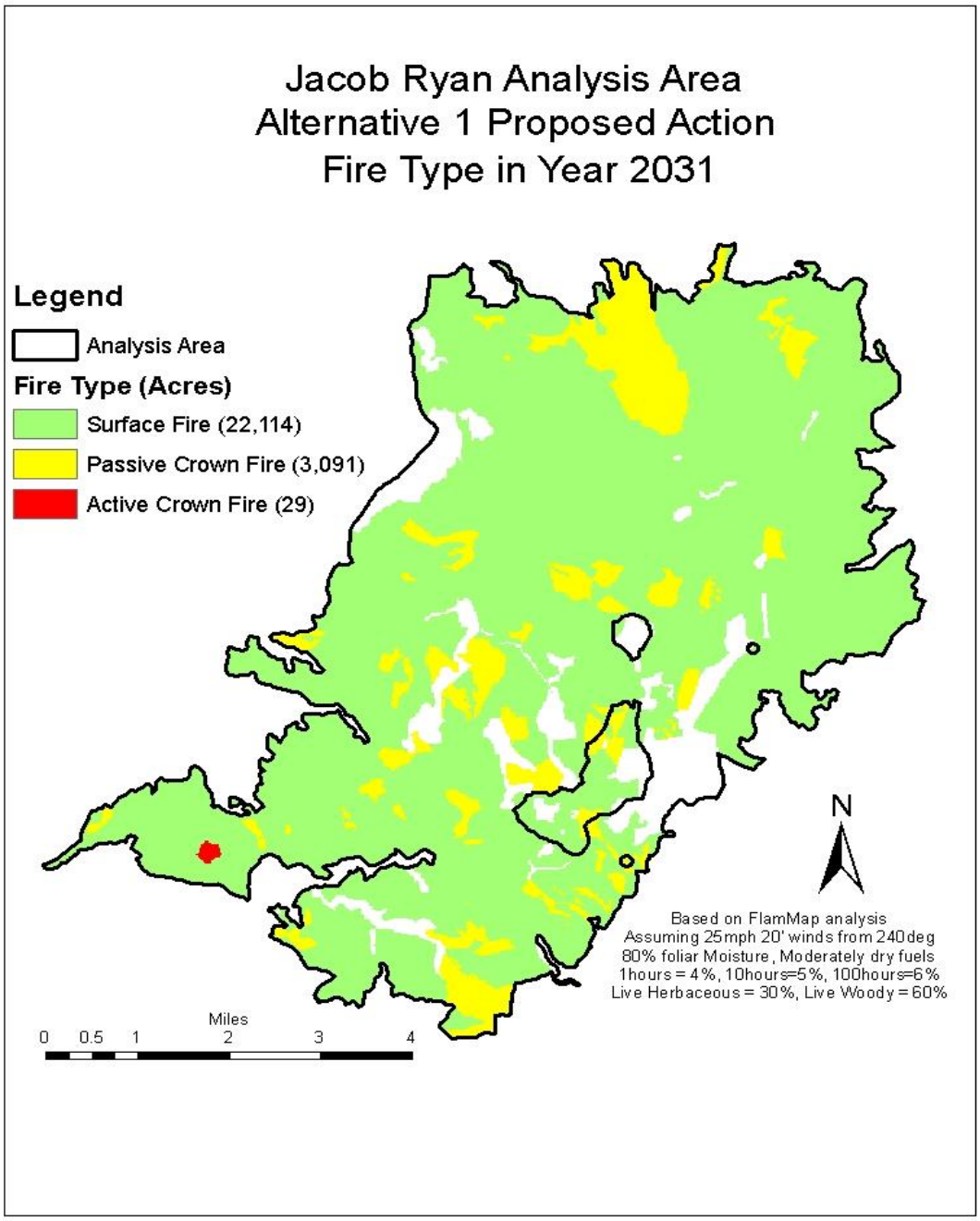

Figure B-1. Map of the JR Area demonstrating the distribution of fire potential for the Modified Proposed Action in 2031 post treatment.

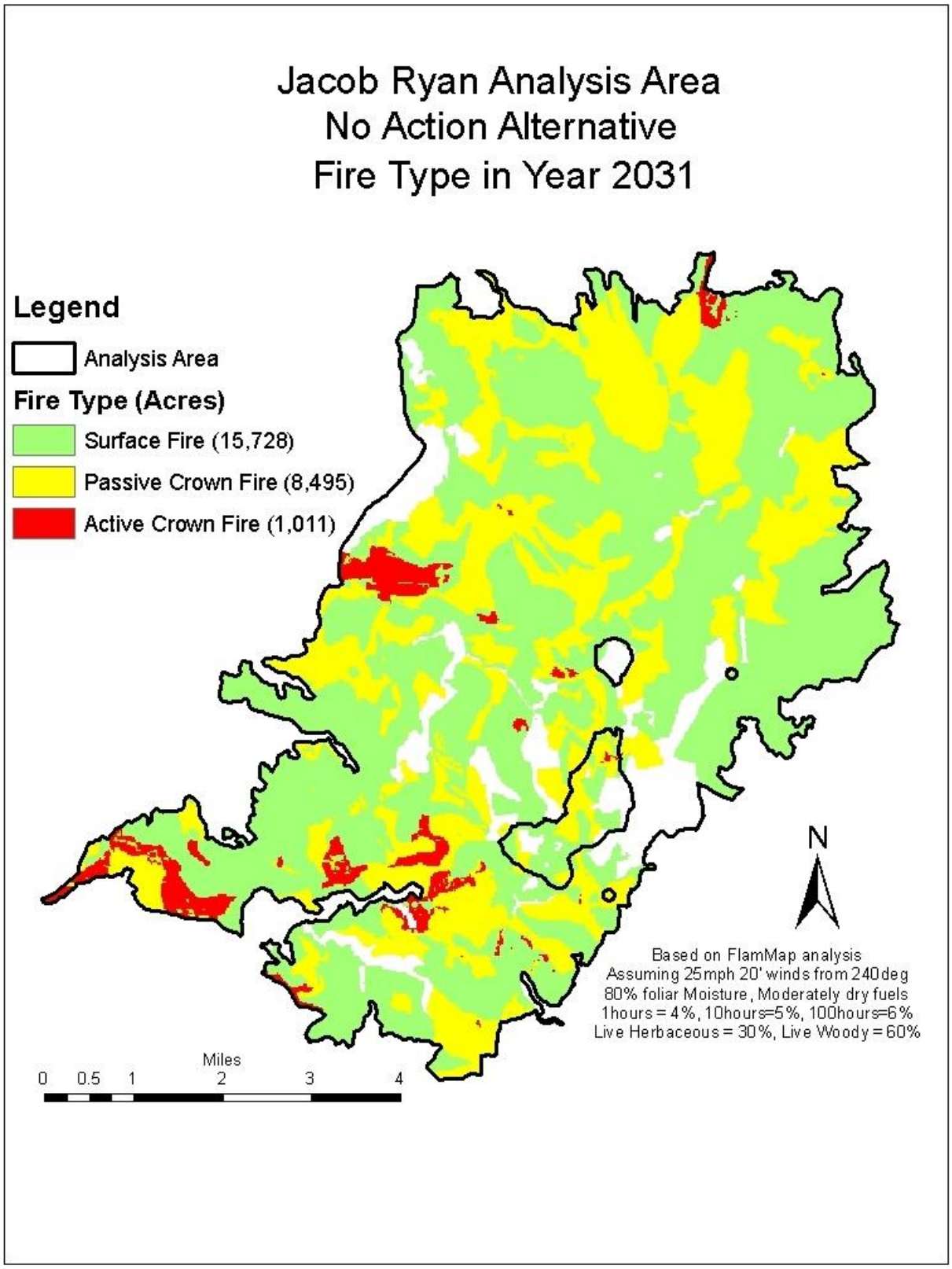

Figure B-2. Map of the JR Area demonstrating the distribution of fire potential for No Action Alternative in 2031 reflecting no treatments.

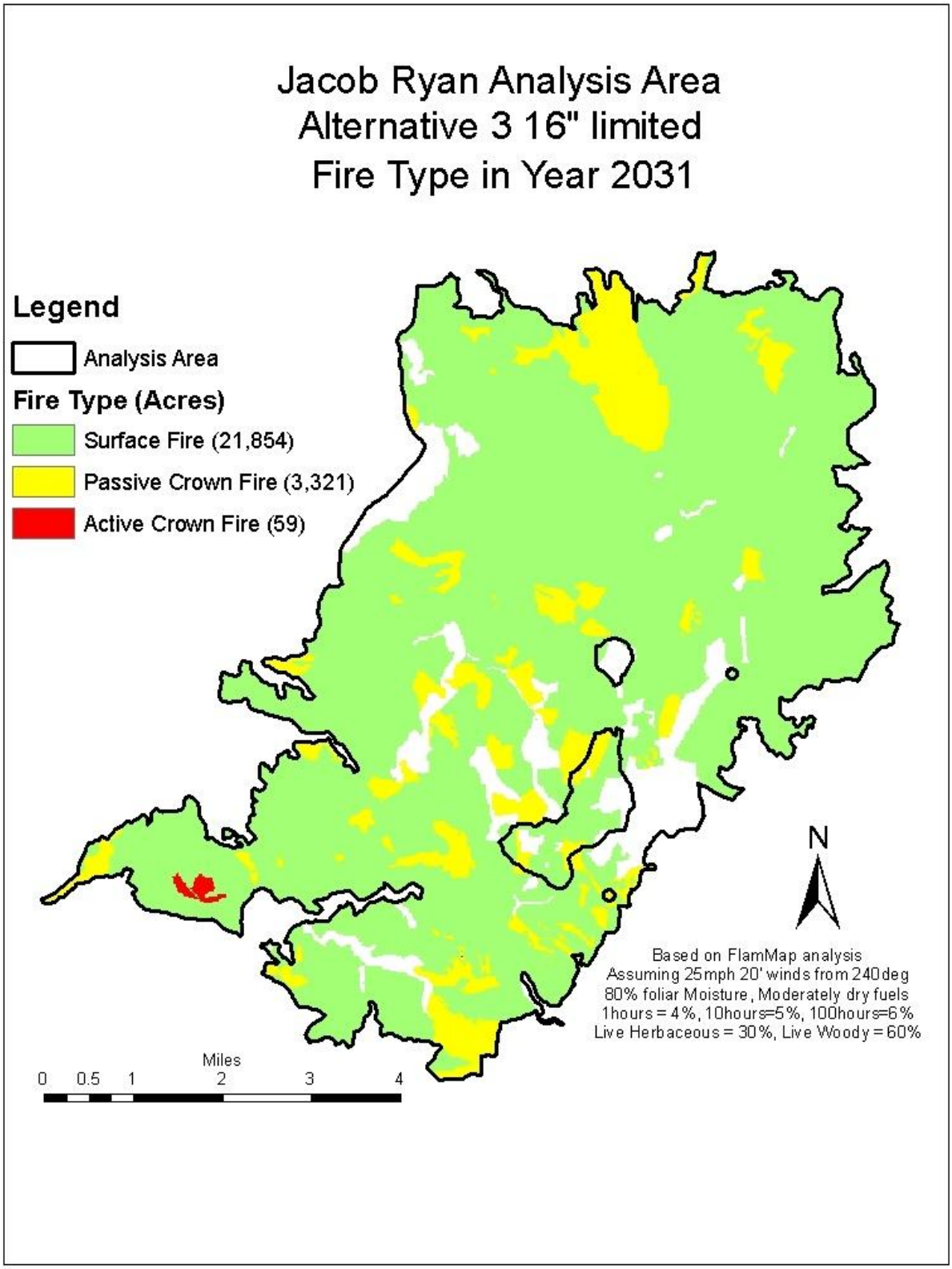

Figure B-3. Map of the JR Area demonstrating the distribution of fire potential for Alternative 3 in 2031 post treatment.

APPENDIX C – 1

Conservation Measures for California Condor

1. At least one week prior to the beginning of any human project-related activity, the district biologist will contact the Peregrine Fund to identify condor locations and type of behavior or activity in or near the activity area. If multiple activities are undertaken within a similar timeframe, condor activity will be monitored by the district biologist during that period rather than for a specific treatment type. Educate all crews about the potential for condors to arrive on-site, and the appropriate actions to take.

2. While nesting activity is likely limited in and adjacent to potential treatment areas, condors may select a nest site within or near the project boundary. If condor nesting activity is identified within 0.5 mile of any treatment area, some types of activity may require adjustments to work areas (i.e. shifting to another area away from nesting area, etc.), or limitations to human disturbance during the nesting season. Different activities have different effects on condor behavior; therefore, no set direction can be given for all activities.

3. The need to alter implementation schedules, adjust work areas, or take other appropriate action will be evaluated by the district biologist and applied when condor nesting near a project site becomes an issue, on a case-by-case basis. The important factor is rapid notification to avoid condor or human injury, and appropriate steps to allow project continuation without interfering with condor behavior.

4. If condors arrive and remain in or very near human activity areas, the following actions will be taken:
   - Elevate the awareness of crews working in the area of the potential for condors to visit an area
   - Educate crews working in the area of potential visitation by condors and how to respond.
   - Prior to the start of a project component, the district contact personnel monitoring condor locations and movement to determine condor status in or near the project.
   - Project workers and supervisors will be instructed to avoid interaction with condors and to contact the appropriate personnel immediately if and when condor(s) occur at a project site.
   - If a condor occurs at the project site, permitted personnel (biologists) will employ techniques to cause the condor to leave the site as necessary. The particular project activity will temporarily cease if injury of a condor is imminent, until a biologist can assess the situation and determine the correct course of action.
   - Project sites will be cleaned up at the end of each work day (i.e., trash disposed of, scrap materials picked up) to minimize the likelihood of condors visiting the site. District condor staff will complete a site visit to ensure adequate clean-up measures.
   - To prevent water contamination and potential condor poisoning, the district-approved vehicle fluid-leakage and spill plan will be adhered to. The plan will be reviewed by the district biologist for adequacy in addressing condors.

APPENDIX C – 2

Mitigation Measures
(Design Specifications & Best Management Practices)

The following is a listing of Mitigation Measures or Design Specifications and Best Management Practices (BMPs) by resource area (including those identified in PR-27). These Design Specifications and BMPs include watershed conservation practices and relevant Forest Plan standards and guidelines, as well as other applicable requirements:

Silviculture

- Interlocking canopy structure: Maintaining existing canopy structure during the creation or restructuring of 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 ROD 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 prescribed 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

To meet the objectives of the Federal Water Pollution Control Act as amended in 1987, the USDA Forest Service, Southwestern Region in 1990 entered into an intergovernmental agreement with the State of Arizona, Department of Environmental Quality. It was agreed that the most practical and effective means of controlling non-point source pollution sources from forest and rangelands was through the development of preventative land management practices generally referred to as Best Management Practices (BMP's), and to ensure the control of non-point source pollution through the implementation of BMP's. Each project is required to identify and implement site specific Best Management Practices designed to protect soil and water quality (Interagency Agreement, 1990). Unless monitoring proves contrary, implementation of the following BMP's constitutes complying with Arizona State and Federal Water Quality Standards for designated uses in downstream perennial waters. The following BMP's are designed to minimize the impacts of timber harvest and fuel treatment activities to soil and water resources. They apply to all action alternatives:

A. 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.

B. 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.

C. Stream Course/Drainage Protection – Stream course and/or drainages to be protected are shown on the sale area map. Stream course and/or drainages are crossed perpendicularly only at designated crossings. Tractor skidding, decking of logs, fire lines, 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 surface runoff is permitted to enter a stream course and/or drainage.

D. Activity generated fuels from timber harvest activities are removed from stream courses and/or drainages. Trees are to be felled outside the stream course and/or drainages. The timber sale administrator has the authority to approve skid trails and log landings outside stream courses and/or drainages.

E. Log Landings – All log landing locations are approved in advance of logging activities by the Forest Service. Existing log landings will be utilized unless locations are deemed unacceptable by the Forest Service (drainage channels, steep slopes, etc). Log landings are not located in sink holes and meadows (TES map unit 9). Log landings will be located where a minimum of clearing or excavating is needed and at least 100 feet away from stream channels/drainages. Landings will be kept to the minimum size necessary to allow safe operations. Log landings are permitted within these map units if the area is less than 15percent slope and is large enough to facilitate a log landing and is accessible by an existing haul road.

F. Erosion Control of Skid Trails, Landings, and Fire lines – All skid trails and fire lines will be water barred and reseeded with an erosion control native seed mix following completion of mechanized

equipment operations. Lopping and scattering of slash can be substituted for water barring if the Purchaser and Forest Service agree. Skid trails and fire lines accessible from open roads will be blocked or disguised to discourage vehicle travel. Depressions such as ruts and berms are filled in or removed, restoring skid trails and fire lines to the natural grade of the slope where possible. A Forest Service approved erosion control seed mix will be applied at a rate of 4 pounds/acre on all skid trails, landings and fire lines. In addition, skid trails and fire lines 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. Lopping and scattering of slash can be substituted for water barring in these areas if the Purchaser and Forest Service agree.

G. Limit the Operating Season – The operation of equipment will be prohibited when soil conditions are such that accelerated soil erosion, excessive soil surface displacement, or excessive compaction would occur. Ground-based mechanical falling, skidding, decking, machine piling and other off-road ground based operations will be stopped in units where soil conditions are such that soil damage is likely. The Sale Administrator will consult with soil and watershed specialist if necessary.

Operations may occur outside the normal operating season (May 1 to November 15) when erosion control work is up to date and when the prohibitive soil conditions described above are not present. Guidelines for winter operations include reasonably dry conditions or a combination of frozen soil and snow cover conditions sufficient to minimize or eliminate soil displacement, compaction, and ground cover disturbance will be required during winter logging operations. The objective is to minimize soil compaction and displacement (rutting, etc). This applies to soils in all TES map units.

H. Soil Loss at Tolerance – Maintain acceptable effective ground cover levels to prevent soil loss from exceeding tolerable soil loss limits. Table 4 in this report presents effective vegetative ground cover (expressed as a percent) at tolerable soil loss levels. Permit light to moderate ground disturbances (vegetative ground cover is disturbed, but not displaced or removed). The Sale Administrator has the authority to require skid trail designation prior to felling to limit ground disturbance. In those areas where severe disturbance has resulted in removal of vegetative ground cover, apply harvest slash, reseed or other erosion control measures to restore the disturbed area. This applies to all TES map units. BMP's C, D, E, F, and G apply to designated skid trails and log landings. BMP's N, O, and P apply to roads.

I. Coarse Woody Debris – To maintain or improve long-term soil productivity, manage towards a minimum of 5 to 7 tons/acre of coarse woody debris. In TES map unit 624, manage towards a minimum of 8 to 16 tons/acre. Coarse woody debris is defined as material greater than 3 inches in diameter. Coarse woody debris should be scattered evenly across the soil surface and represent all size classes where possible. Unmerchantable or cull trees are to remain on site and not brought into landing or decking areas. In areas (TES map unit 293 in the Marble Canyon Watershed, TES map unit 620 in the Kanab Creek Watershed and TES map Unit 624) where coarse woody debris is deficient, lop and scatter slash to meet this guideline. Also, lop and scatter slash in TES map unit 9. This BMP does not apply to urban interface areas or fuel breaks.

J. Machine Piling of Slash – Machine pile activity generated fuels at log landings and where fuel loading exceeds target levels for Coarse Woody Debris. All machine piling will be accomplished using a Forest Service approved brush rake in order to minimize displacement of soil and rock. Machine pile when soils are frozen or dry. Machine piling of slash is not permitted in TES map unit 9. Lop and scatter activity generated fuels in TES map unit 9. A Forest Service approved erosion control seed mix is applied at a rate of 4 pounds/acre on all landings. Reseed with native grass species.

K. Hand Piling of Slash – Do not hand pile slash in designated stream courses or drainages, springs, seeps, or other designated protected areas. Lop and scatter activity generated fuels in TES map unit 9. Hand piling and burning of PCT slash can occur in Map Unit 9 only in those locations where resulting fuel loads exceed 10 tons per acre. Where appropriate, reseed with native grass species.

L. Broadcast Burns – Conduct broadcast burns when moisture and temperature conditions are suitable for

burning that reduces fuels without totally consuming forest duff, completely removing effective vegetative ground cover and exposing bare soil. 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 percent) at tolerable soil loss levels. Reseed severely burned areas with a Forest Service approved erosion control seed mix applied at a rate of 4 pounds/acre. Reseed with native grass species. No broadcast burning is permitted in TES map unit 9 due to unsatisfactory soil conditions.

M. Road Maintenance – Existing and roads to be opened for administrative use are maintained throughout the life of the timber sale. Ensure that existing 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. Forest Service will determine if additional or new drainage structures are needed.

N. 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.

O. Administrative Roads to Be Closed – Roads are lightly scarified and reseeded with native grasses species effective in controlling surface erosion. Road berms are removed and ruts are filled in. Existing drainage control structures are cleaned, maintained and are working effectively. If possible, camouflage or block the road entrance to disguise the road closure.

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

Q. 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.

- 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 rest/rotation is 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 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 on trees specifically designated for protection
- 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 within 200 feet of any Forest Service system road or within 50 feet of any system trail, use a bark-colored paint mix to cover such marks no later than the end of the season that harvest occurs, 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.
- Keep stump heights low (6 inches) within 50 ft. of trail edges.
- If sanitation cuts are used to reduce mistletoe, feather edges up to the treatment areas to avoid abrupt changes in tree densities.
- Do not agree to skid trails that intersect Forest Service system roads at right angles. 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

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.
- 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.
- 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.
- 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.
- Limit human activities in or near nest sites and post-fledgling family area's (PFA's) during the breeding season so that goshawk reproductive success is not affected by human activities. The breeding season extends from March 1 through September 30.
- In northern goshawk replacement nest areas, tree-groups may be thinned from below; removing, in order: (1) mistletoe infected, (2) suppressed, (3) intermediate, and (4) co-dominant individuals. Promote varied, irregular spacing between trees.
- In northern goshawk replacement nesting areas, preferred method for treating woody debris is fire use, next, lopping and scattering, and last, hand piling. Avoid slash piling with crawler tractor.
- For nest stand areas (Forest Plan, p. 30): (1) Preferred treatments to maintain the desired structure are to thin from below with non-uniform spacing and use of hand tools and fire use to reduce fuel loads. (2) Lopping and scattering of thinning debris is preferred if prescribed fire cannot be used. (3) Piling of debris should be limited. When necessary, hand piling should be used to minimize compaction within piles and to minimize displacement and destruction of the forest floor and the herbaceous layer. (4) Do not grapple or dozer pile debris. (5) Use small, permanent skid trails in lieu of roads for timber harvesting.

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.