United States
Department of
Agriculture

Forest
Service

**Southwestern
Region**

Draft Environmental Impact Statement for Kachina Village Forest Health Project

Mormon Lake Ranger District, Coconino National Forest

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Coconino National Forest
2323 E. Greenlaw Lane
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Kachina Village Forest Health Project
Draft Environmental Impact Statement
Coconino County, Arizona

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Abstract: This Draft Environmental Impact Statement (DEIS) describes the effects of implementing five alternatives for improving forest health and reducing wildfire potential on National Forest System land in the Coconino National Forest. The project is adjacent to the community of Flagstaff in northern Arizona. The preferred alterative (Alternative A) would reduce fuels and lower wildfire potential by thinning trees and broadcast burning, and reduce fire risk through improvements in recreation and road management. Thinning would occur on nearly 4,800 acres and broadcast burning would occur on 6,300 acres. Management activities will improve forest health, wildlife habitat, soil and watershed conditions in the area. Alternatives C and D place diameter limits on the size of trees to be thinned. Alternative E treats most of the project area without the use of mechanical equipment and treats the areas immediately adjacent to homes with a more intensive treatment. All alternatives treat the same acres, however, the alternatives vary by diameter limit and intensity of treatments and use of mechanized equipment. The major issues identified during scoping focused on the effects to old growth, wildfire potential, effects on soil, water quality, and wildlife habitat.

Reviewers should provide the Forest Service with their comments during the review period of the Draft Environmental Impact Statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the Final Environmental Impact Statement, thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewer's position and contentions. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the Final Environmental Impact Statement. City of Angoon v. Hodel (9th Circuit, l986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the Draft Environmental Impact Statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

Send Comments to:	Debbie Kill Peaks Ranger District 5075 N. Highway 89 Flagstaff, AZ 86004 (928) 526-0866
Date Comments Must Be Received:	

Summary

The Kachina Village Project Area is located south of Flagstaff and continues south of the communities of Kachina Village and Forest Highlands. Interstate Highway 17 and U.S. Highway 89A border the project area on the east and west, respectively. The southern boundary is approximately one half mile south of James Canyon. Kelly Canyon, Pumphouse Wash, James Canyon, and Mexican Pocket are prominent features and locations within the project boundary. The entire project encompasses 10,417 acres: 2,377 acres of private land, 326 acres of state land, and 7,714 acres of Forest Service land.

The Proposed Action proposes to thin approximately 4,800 acres; broadcast burn and maintenance burn the entire project area, except for canyons and steep slope, 6,229 acres; reduce road density; construct several new trails; designate dispersed camping areas and close high fire risk areas to camping. Thinning from below results in the removal of smaller, unhealthy trees first, then progresses until the desired tree numbers are reached.

One clarification to the Proposed Action was to change the description of "old tree" or "yellow barked" trees to the new language that reads "Retain all existing mature ponderosa pine trees or 'yellow-barked' trees." The second clarification, due to a computer error, was to add 50 acres of thinning in unit 335/04 (29 acres) adjacent to private land and in unit 3236/07 (20 acres).

A Notice of Intent to prepare an Environmental Impact Statement (EIS) was published in the Federal Register on March 9, 2001 (PRD 31). Public meetings were held in February, March, and April of 2001 to provide project area information, develop the desired future condition, and discuss local concerns and interests that should be addressed in the Kachina Village Forest Health Project analysis. Over 50 people attended the meetings. In June 2001, a letter providing information and seeking public comment was mailed to approximately 100 individuals and groups. This included Federal and state agencies, Native American groups, municipal offices, businesses, interest groups, and individuals. A total of twelve responses to this initial mailing were received (PRD 93 –Proposed Action Mailing List). Announcements regarding the project were printed in the *Arizona Daily Sun* on March 30, 2001 (PRD 53). Various field trips were held and meetings occurred with members of other agencies.

Significant issues are as follows:

Issue 1: Cutting trees greater than 16-inch diameter would affect future old-growth in the area, resulting in fewer acres being able to qualify as old-growth forest structure in the future.

Issue 2: All project objectives could be met with an 18-inch diameter limit and request that a quantitative analysis be provided.

Issue 3: The Proposed Action does not reduce fuels sufficient to protect the immediate wildland-urban interface. An "intensive treatment zone" around private land is requested for evaluation.

Issue 4: Thinning north of Kelly Canyon as described in the Proposed Action goes beyond what is needed to reduce fire risk. A lighter treatment of 60 to 120 basal area and a 9-inch thinning limit (where a temporary road is needed) is requested for evaluation.

Issue 5: Temporary roads lead to increased soil compaction, transport of exotic weeds, and have long-lasting impacts on forest structure, therefore, we request that no new temporary roads be created even if only for the duration of the project.

Issue 6: Mechanized equipment and excessive thinning will increase soil compaction and cause disturbance to wildlife in areas south of Kelly Canyon. The area south of Kelly Canyon should only be treated with hand thinning and was requested for evaluation.

Alternatives include the Proposed Action (Alternative A), No-Action (Alternative B) and three other action alternatives. The action alternatives are differentiated by changes in intensity of thinning prescriptions[1], the size of the trees to be thinned, and the use of temporary roads. Some items are common to all action alternatives. These include slash treatment and broadcast burning; thinning in Mexican spotted owl Protected Activity Centers; thinning in a wildlife movement corridor; changing some areas to day-use recreation only; adjusting dispersed camping to designated sites in some areas; identifying and constructing trails and trailheads; maintaining some roads and closing others; restoring riparian habitat at a seep; and retaining all existing mature (old or "yellow-barked") trees.

[1] In all action alternatives, thinning from below results in the removal of smaller, unhealthy trees first, then progresses until the desired tree numbers are reached.

The action alternatives are differentiated as follows:

Alternative A - Proposed Action cutting some trees over 16-inch diameter at breast height (DBH) under specific criteria only.

Alternative B - No Action.

Alternative C - Proposed Action cutting no trees over 16-inch DBH.

Alternative D - Proposed Action cutting some trees over 16-inch DBH under specific criteria only and cutting no trees over 18-inch DBH.

Alternative E - Proposed Action with modifications based on issues of roads and concerns for wildlife habitat posed by the Southwest Forest Alliance.

The action alternatives are differentiated primarily by a limit on the size of tree to be thinned, the intensity of the treatments proposed in thinning units, and the miles of temporary road.

The number of acres where high intensity crown fire is reduced is 4,266 in Alternatives A, C and D and 2,328 in Alternative E. Reducing the risk of high intensity crown fire is important to retaining important human and resource values such as nearby subdivisions, the Oak Creek Watershed, threatened species habitat, recreation opportunities, and scenery. Alternative B does not change expected fire behavior.

Diameter limits affect the ability to create and maintain grassy openings. Alternatives A and D are expected to achieve 5.5 percent of the project area in grassy openings, while Alternative C is expected to result in 3 percent, and Alternative E is expected to result in 1 percent. Alternative B maintains .5 percent of the area in openings. Openings add to biodiversity and are important to grass dependent wildlife species.

All action alternatives continue to provide portions of the project area in dense forest conditions, thus maintaining habitat for species that require dense forest.

The ability of the forest to withstand insect and disease such as bark beetle and mistletoe is improved on 4,266 acres in Alternatives A, C and D and 2,328 acres in Alternative E. Alternative B maintains most of project area in moderate to high risk of damage from insects and disease.

Alternatives A, C, and D improve the Vegetative Structural Stage (VSS) distribution and Alternative E improves VSS distribution to a lesser degree. Under Alternatives A, C, and D, in 50 years, VSS 5 (trees 18 inches and greater) would be 27.5 percent of the project area and VSS 6 (old-growth trees) would be 4.5 percent. This nearly meets the VSS 5 and 6 guidelines in the Forest Plan. Alternative E results in 10 percent VSS 5 and 3 percent VSS 6. Alternative B results in 6 percent VSS 5 and 3 percent VSS 6. All alternatives retain existing mature ponderosa pine trees or old “yellow-barked” trees.

The miles of temporary roads are 5.75 miles in Alternatives A, C, and D and 2.5 miles in Alternative E. Alternative B has no effect from temporary roads. All action alternatives intend to rehabilitate 17.65 miles of existing roadway by closing, scarifying, and revegetating. Alternative B conducts road management according to current guidelines and schedules. Under Alternative E, only 2,330 acres will be mechanically treated or a little over half of the other action alternatives. However, provided that mitigation measures are followed, there will be only minor impacts to on-site soil quality for areas where equipment is used.

All alternatives change some areas to day-use recreation, adjust dispersed camping to designated sites, identify and construct trails and trailheads, and design and maintain an appropriate open road system. Where these actions occur, there would be improved wildlife habitat and watershed conditions and a decrease in the risk of human-caused wildfires.

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Chapter 1 • Proposed Action

Introduction

The Forest Service has prepared this Environmental Impact Statement (EIS) on the potential effects of management actions on national forest lands within the Kachina Village Forest Health Project area (Figure 1). Management actions will include the use of broadcast burning, thinning from below, and access and recreation management to address declining and poor forest health and high fire hazard conditions. Thinning from below results in the removal of smaller, unhealthy trees first, then progresses until the desired tree numbers are reached.

The project area is located south of Flagstaff, Arizona on the Mormon Lake and Peaks Ranger Districts of the Coconino National Forest. The project area is adjacent to the communities of Kachina Village and Forest Highlands and includes Pumphouse, Kelly, and James Canyons. The project area includes both private and state land, in addition to national forest land. The Forest Service will only make decisions for Forest Service lands.

This EIS discloses the direct, indirect, and cumulative environmental impacts and any irreversible or irretrievable commitment of resources that would result from the Proposed Action and alternatives.

The project is in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and state laws and regulations. This EIS is prepared according to the format established by Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500-1508). In addition to explaining the purpose and need for the Proposed Action, Chapter 1 discusses how the Kachina Village Forest Health Project relates to the Coconino National Forest Plan (Forest Plan). Chapter 1 also identifies the significant issues driving the EIS analysis. Chapter 2 describes and compares the Proposed Action, alternatives to the Proposed Action, and a no-action alternative. Chapter 2 also summarizes the environmental consequences by issue. Chapter 3 describes the natural and human environments potentially affected by the Proposed Action and the alternatives. Chapter 3 also discloses the potential effects that are anticipated. Chapter 4 contains the list of preparers, Chapter 5 contains the EIS distribution list, and Chapter 6 contains the literature cited. Appendices provide additional information on specific aspects of the proposed project. This EIS incorporates documented analyses by summarization and reference, where appropriate.

The interdisciplinary team used a systematic approach for analyzing the proposed project and its alternatives, estimating the environmental effects, and preparing this EIS. The planning process complies with NEPA and the CEQ regulations. Planning was coordinated with the appropriate Federal, state, and local agencies, and local, Federally-recognized tribes.

The Draft EIS is available online at http://www.fs.fed.us/r3/Coconino/nepa.shtml. Copies can be obtained from the Peaks Ranger District, 5075 N. Highway 89, Flagstaff, AZ 86001 or by calling (928) 527-8280. The comment period is 45 days and will begin when the notice of availability is published by the Environmental Protection Agency in the Federal Register.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Peaks Ranger District office. These records are available for public review.

Background

The following background information is from the Forest Service publication "Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy," October 2000.

> *The 2000 fire season was undoubtedly one of the most challenging on record. As of early October, more than 6.8 million acres of public and private lands burned—more than twice the 10-year national average. The magnitude of these fires is the result of two primary factors: a severe drought, accompanied by a series of storms that produced thousands of lightning strikes followed by windy conditions; and the long-term effects of almost a century of aggressively suppressing all wildfires that has led to an unnatural buildup of brush and small trees in forests and rangelands.*
>
> *On August 8, 2000, President Clinton asked Secretaries Babbitt and Glickman to prepare a report that recommends how best to respond to this year's severe fires, reduce the impacts of those fires on rural communities, and insure sufficient firefighting resources in the future. On September 8, 2000, President Clinton accepted their report Managing Impacts of Wildfires on Communities and the Environment.*

> *Operating principles directed by the Chief of the Forest Service in implementing this report include: firefighting readiness, prevention through education, rehabilitation, hazardous fuel reduction, restoration, collaborative stewardship, monitoring, jobs, and applied research and technology.*

The hazardous fuel reduction portion of this strategy called for: "Assign highest priority for hazardous fuels reduction to communities at risk, readily accessible municipal watersheds, threatened and endangered species habitat, and other important local features, where conditions favor uncharacteristically intense fires." The Kachina Village Forest Health project is proposed in response to the fuels reduction element of the Cohesive Strategy.

Grand Canyon Forests Partnership

The Grand Canyon Forests Foundation (a nonprofit organization) and the Coconino National Forest have established a cooperative agreement to work together to demonstrate new forest management approaches in improving and restoring the ecosystem health of the ponderosa pine forest ecosystem where urbanized areas interface with national forest lands (Flagstaff Wildland-Urban Interface). This cooperative effort seeks to involve the greater Flagstaff community extensively to develop a community-based solution to local forest health problems. This cooperative project is called the **Grand Canyon Forests Partnership**.

The Kachina Village Forest Health Project Area is the second 10,000-acre area the Partnership has studied in detail. This area is located south of Flagstaff and directly adjacent to the communities of Kachina Village and Forest Highlands. The project was selected for five primary reasons:

- The threat of catastrophic fire to all the above mentioned communities and habitat that is important to wildlife, including the Federally threatened Mexican spotted owl;
- The density of the pine forest (concern for catastrophic wildfire, loss of plant species, and concern for loss of old-growth habitats for wildlife);
- The high recreation use and concerns for high fire risk;
- Declining forest health and loss of understory community; and
- The impact of a large wildfire on the Oak Creek Watershed.

This EIS is for the Kachina Village Forest Health Project area. Research and monitoring of the various treatments will be used to guide future projects.

The Kachina Village Forest Health Project analysis follows current Forest Plan direction. There is another planning effort called the Flagstaff Lake Mary Ecosystem Analysis (FLEA). The FLEA process will result in a Forest Plan amendment to update, change, or create new management direction for lands around Flagstaff. The wildland-urban interface will require many different treatments and management scenarios to lessen fire risk and fire potential and to provide for wildlife and human habitats.

Coconino National Forest personnel conducted resource inventories in 2000 and 2001. Detailed data documentation for each activity is located in files maintained by resource specialists at the Peaks and Mormon Lake Ranger District offices. Summaries of the data collected and all documentation of alternative development are located in the project record file maintained at the Peaks District office.

A Vision for the Future

The Partnership's vision is consistent with the Coconino National Forest Plan and generally follows management recommendations outlined in "A Vision for our Community - Flagstaff 2020" and the "Flagstaff Area Open Spaces and Greenways Plan."

> *"In the near future, the wildland-urban interface will be a mosaic of open, park-like forests containing scattered timber stands with higher densities, interspersed with natural parks which approximate—although do not duplicate—conditions present before Euro-American settlement. Forests and woodlands will be dominated by open growing clumps of large and/or old trees in a matrix of native bunchgrasses, wildflowers, and shrubs. Parks (meadows) will be dominated by native grasses and wildflowers. Periodic low-intensity fires will maintain open habitats, cycle nutrients, and keep wildland fuel levels low, reducing the hazard of catastrophic crown fires. The presence of introduced species will be greatly diminished and native wildlife species will occupy their original niches within the ecosystem, moving freely through*

established wildlife corridors. A broad spectrum of uses—based upon science and adaptive ecosystem management principles—will be enjoyed by northern Arizona residents and visitors. Although the majority of the landscape will be restored to more natural conditions, some will be retained in basically its current condition to address specific, well-defined management goals."

Proposed Action

A "proposed action" is defined early in the project-level planning process. A proposed action serves as a starting point for the interdisciplinary team (IDT) and gives the public and other agencies specific information on which to focus comments. The Proposed Action proposes thinning, prescribed burning, road and recreation management activities to improve declining forest health and reduce wildfire potential. Several thinning prescriptions are proposed to create a mosaic of resulting stand densities. The Coconino National Forest proposes the following actions:

- Thin approximately 4,800 acres;
- Broadcast burning and maintenance burning the entire project area, except for canyons and steep slopes, 6,229 acres;
- Reduce road density;
- Construct several new trails; and
- Designate dispersed camping areas and close high fire risk areas to camping.

The Proposed Action is described in detail in Chapter 2, "Actions Common to All Alternatives" and "Proposed Action (Alternative A)." Using comments received on the Proposed Action (see discussion of Significant Issues later in this chapter) and information from preliminary analysis, the interdisciplinary team then develops alternatives to the Proposed Action. These are discussed in detail in Chapter 2.

Based on public comment received to the Proposed Action, two slight modifications were made to the Proposed Action. The first is a clarification in language. There was concern about the description in the Proposed Action regarding "old trees" or "yellow-barked" trees and the age of these trees as described as 150 years or older. We have deleted from the Proposed Action language the descriptive words "150 years or older." The new language reads, "Retain all existing mature ponderosa pine trees or 'yellow-barked' trees."

The second modification of the Proposed Action is the addition of approximately 50 acres of treatment. This includes loction/site 335/04 (29 acres) adjacent to private land. The exclusion of this stand from the "Proposed Action" was a Geographic Information System (GIS) error. In addition, location/site 336/07 will be thinned by hand in selected areas (approximately 20 acres) to reduce ladder fuels immediately adjacent to private lands.

Decisions to Be Made

Based on the environmental analysis in this EIS, the Coconino National Forest Supervisor will decide whether and how to improve forest health conditions and reduce fuel loading in the Kachina Village Forest Health Project area in accordance with Forest Plan goals, objectives, and desired future conditions. This decision could include:

- The location, design, and scheduling of the activities, temporary road construction and reconstruction, silvicultural practices, prescribed burning and recreation management;
- The estimated timber volume, if any, to make available from the project area at this time (and the number and size of the timber sales/goods for services contracts);
- Access management measures; and
- Mitigation measures and monitoring requirements.

Project Area

The Kachina Village Project Area is located south of Flagstaff and continues south of the communities of Kachina Village and Forest Highlands (See Figure 1). Interstate Highway 17 (I-17) and U.S. Highway 89A (89A) border the project area on the east and west, respectively. The southern boundary is approximately one half mile south of James Canyon. Kelly Canyon, Pumphouse Wash, James Canyon, and Mexican Pocket are prominent features and locations within the project boundary. The boundary encompasses an area that has the potential to be affected by a wildfire within one to two burning periods following ignition during high and/or extreme burning conditions.

The entire project encompasses 10,417 acres: 2,377 acres of private land, 326 acres of State Trust Land (State), and 7,714 acres of Forest Service land. The

Forest Plan includes portions of the following Management Areas: MA3, MA4, MA6, MA9, MA12, MA15, and MA17. The project occurs predominately on MA3 lands that is ponderosa pine on slopes less than 40 percent. The other management areas cover steeper slopes, meadows, riparian, and developed recreation sites.

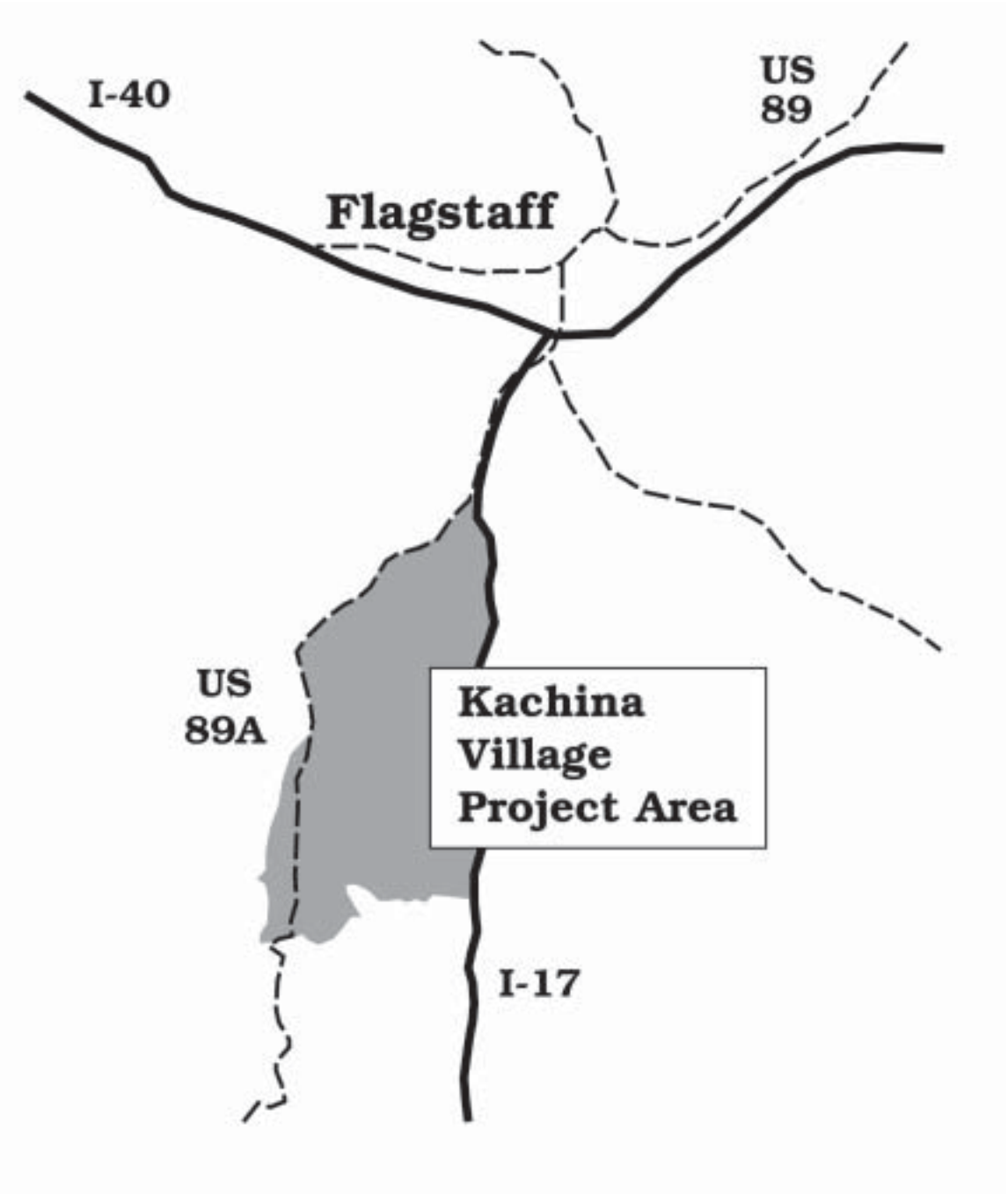

Figure 1. The Kachina Village Forest Health Project Area, Coconino National Forest, Arizona.

Purpose and Need

The Kachina Village Forest Health Project is currently proposed in response to the Grand Canyon Forests Partnership Cooperative Project, the National Fire Plan, and the implementation of the Coconino National Forest Plan. The goals and objectives of these plans are to improve forest health and to help move the project area toward desired future conditions described in the plans. The Forest Plan includes forest-wide goals and objectives and goals, objectives, and desired future conditions specific to management areas. The goals and objectives of the Kachina Village Forest Health Project are listed below and additional detail is provided in the Project Area Existing Conditions, Desired Conditions and Needs that follow.

- Manage forest fuels and fire risk to reduce the potential for a large, stand-replacing fire in the Wildland-Urban Interface and to create forest conditions from which a crown fire would be unlikely to originate under moderate fire weather.
- Address and correct historical causes of ecosystem degradation to increase overall forest ecosystem resilience to disturbance events, including fire, drought, and insects.
- Protect habitat for all Threatened, Endangered, and Sensitive species, including Mexican spotted owls and northern goshawks, by reducing the probability of stand-replacing fire in forested habitats and through integrated measures to protect wildlife habitat.
- Protect black bear, turkey, Abert squirrel, and other wildlife species associated with dense habitat by incorporating special design features and to continue to provide habitat for these species in the project area, including important wildlife habitats such as cover areas and movement corridors.
- Protect and enhance the quality of the Oak Creek Watershed by reducing the probability of stand-replacing fire.
- Improve and enhance understory productivity, which has been negatively impacted by increased overstory densities.
- Retain, enhance, and recruit mature or "old yellow" ponderosa pine and Gambel oak, which are declining in longevity and frequency.
- Create the conditions necessary for the reintroduction of fire to the ecosystem.
- Increase the diversity of age classes within the forest to provide northern goshawk habitat[1].
- Manage access, road networks, and recreation to decrease fire starts, maintain fire suppression access, and to better balance the needs of people with wildlife habitat and watershed and soil conditions.
- Restore and protect riparian habitats.

Additional goals and objectives that apply to the Kachina Village Project and are incorporated into the design of the project include:

- Research and demonstrate key ecological, economical, and social dimensions of forest health improvement efforts;
- Protect cultural sites[2]; and
- Provide access for the proposed treatments.

Applicable National Fire Plan goals and objectives include:

- Reducing the number of small fires that become large;
- Restoring natural ecological systems to minimize uncharacteristically intense fires;
- Creating new jobs in both the private and public sectors;
- Improving the capabilities of state and volunteer fire organizations; and
- Reducing the threat to life and property from catastrophic wildfire.

Goals, objectives and desired future conditions of the management areas within the project area are described in the following section.

Relationship to Forest Plan

National forest planning occurs at several levels, including the national, regional, forest, and project level. The Kachina Village Forest Health Project EIS

[1] Desired conditions for northern goshawk habitat are described in Amendment 11 of the Forest Plan.

[2] Protection refers to management activities and also damage from wildfire.

is a project-level analysis. The scope of the EIS is confined to addressing the significant issues and possible environmental consequences of the project. It does not attempt to address decisions made at higher levels. It does, however, implement direction provided at those higher levels.

The Forest Plan embodies the provisions of the National Forest Management Act, its implementing regulations, and other guiding documents. The Forest Plan sets forth, in detail, the direction for managing the land and resources of the Coconino National Forest. Where appropriate, the Kachina Village Forest Health Project EIS tiers to the Forest Plan FEIS, as encouraged by 40 CFR 1502.20.

The Forest Plan uses management areas to guide management of the national forest lands within the Coconino National Forest. Each management area provides for a unique combination of activities, practices, and uses. The Kachina Village Forest Health Project area includes many management areas. Goals, objectives, and desired future conditions of each management area are described in the Forest Plan and subsequent Amendments. In addition, the Forest Plan (Chapter 4) contains a description of each management area.

Project Area Existing Conditions, Desired Conditions and Needs

This section describes in more detail how the current conditions specific to the Kachina Village project area differ from desired conditions. This comparison results in a description of where there is a need for action to progress toward desired conditions. The desired conditions described for the Forest Plan management areas, in conjunction with the other Forest Plan directions outlined above, provide the parameters for identifying and defining project-specific desired conditions. The following desired conditions will help guide management of the project consistent with the Forest Plan, the significant issues (described below), and the ecological conditions of the project area.

Existing and desired conditions are compared below. The resulting purpose and need for action are written in bolded italics. Chapter E of the Project Record File and specifically PRD 49 clarifies the desired condition, as developed by the Partnership, the public, and the IDT working on this project.

Fire Risk and Fire Potential: Existing forest conditions include continuous canopies, high stand densities over 120 Basal Area[3], and unnaturally high fuel loads. The current forest conditions are conducive to future catastrophic wildfires. Current high recreational use increases the risk of a fire starting from escaped campfires, inappropriate disposal of cigarettes, and catalytic converters. Unlike the low intensity ground fires of the past, fires will likely travel through the tree tops (crown fires), resulting in greater intensity fire and increased destruction. The potential losses from such fires are high. The communities of Kachina Village, Forest Highlands, and Flagstaff are located north and upwind of the project area. Other values at risk from fire include threatened Mexican spotted owl habitat, northern goshawk habitat, and areas that provide recreation opportunities for the public. Existing conditions show that stands within the project area will produce flame lengths of 5.7 to 7.2 feet resulting in a high likelihood of producing and supporting running crown fires that are difficult, or more likely impossible, for firefighters to control. The desired condition is a forest with low to moderate fire potential with reduced flame lengths below 4 feet.

Changes in camping locations and camping closures are important in reducing the risk of human-caused fires. Associated benefits of designated camping are reduced fire risk and improved watershed, soil, and recreation management.

> *Need to change flame lengths of 5.7 to 7.2 feet (existing condition) to flame lengths of 4 feet or less (desired condition) in an arrangement that creates discontinuous canopies across the project area. The risk of, and potential for, catastrophic wildfire is achieved by creating discontinuous tree canopies, removing ladder and fuels on the forest floor, and, in general, creating conditions that were prevalent prior to the disruption of natural ecosystem processes. Camping closures and the designated camping areas will change the distribution and location of human-caused fires to improve and lower fire risk.*

Plant and Animal Diversity: Today, the landscape within the Kachina Village Project area is 99 percent forested, with only 1 percent of the area in openings. Very little understory grasses, forbs, and shrubs currently exist. Additionally, only a small portion of

[3] Basal area is a measure used to describe tree density. Basal area can be visualized as the amount of ground that is covered in wood. Higher basal areas mean more trees are left (higher densities) than lower basal areas (lower densities).

the area is in old-growth conditions, with most of the ponderosa pine stands in small and medium pole timber stages (trees 5 to 16-inches dbh). There are few seedlings/saplings or mature "yellow" pine trees. The overwhelming majority of plant biological diversity is in the understory community. The diversity of understory plants, in turn, comprises the essential habitat for many species of native fungi, soil microorganisms, arthropods, mammals, and birds. Currently, the lack of fire in the understory is another factor that limits plant diversity and vigor. Per northern goshawk Amendment 11 of the Forest Plan, the desired condition is to return, in part, to ponderosa pine ecosystems that are more open, with grassy openings comprising 10 percent of the area. Additionally, the desired condition is for a mix of tree sizes and ages described in the Forest Plan that represents a more even representation of each size class and a greater percentage of large old trees on the landscape. This desired condition is a better balance of ponderosa pine age and size classes and a greater component of grasses, shrubs, and forbs are required to meet biological needs. Another desired condition is recurring, low-intensity fire that recycles nutrients and maintains forest understory health in ponderosa pine ecosystems.

Need to change from 1 percent openings to 10 percent openings across the area. Need to move from 60 percent young forest (VSS3) to 20-30 percent young forest, to achieve long-term goals of 40 percent mature and old forest (VSS 5 & 6) to 40 percent mature and old forest. There is a need to reintroduce recurring, low-intensity fire.

Old-growth: Historically, old-growth ponderosa pine in the Flagstaff area ranged in density from 0 to greater than 100 trees per acre, with an average of 26 old-growth trees per acre. Today, the density of old-growth trees is very different. Across the entire project area, the average density of old-growth trees is 4 per acre. There are 0 to 2 old-growth trees per acre on 38 percent of the area; 2 to 4 old-growth trees per acre on 23 percent of the area; 5 to 7 old-growth trees per acre on 20 percent of the area; and 8 and greater old-growth trees per acre on 19 percent of the area. The vigor and longevity of existing old-growth trees is variable depending on a particular site, and competition from surrounding younger trees. The desired condition is 20 to 30 old-growth trees per acre or 40 percent of the project area in mature or very old trees (VSS 4 and 5). The desired condition is to maintain the current old-growth trees for as long as possible given the relatively low number and length of time until other trees can grow to replace them.

Need to promote future old-growth trees to replace existing trees in the future and add to the overall amount of old-growth trees. Need to reduce competition between trees immediately surrounding old-growth trees to promote the vigor of existing old-growth trees, thus increasing their resistance to insects and disease and increasing longevity.

Recreation and Roads: Many people enjoy the forest roads or travel cross-country on foot, mountain bikes, and motorcycles. Recreation use in this area is very high. Recreation monitoring has documented approximately 400 dispersed recreation sites and numerous transient camps across the entire project area. Furthermore, there are approximately 4 miles of open Forest Service system roads per section (640 acres). This current road density is two times greater than the desired condition suggested by the Forest Plan. In addition, there are numerous unofficial roads created by hunters and recreationists, as indicated by the presence of 2-track dirt depressions. As a result, there are few places where a person can gain a sense of solitude and enjoy nature. The entire road network allows a great deal of mobility throughout the area. However, Forest Service road budgets do not allow for maintenance of all the current system roads and there is no maintenance of unofficial roads.

Heavy recreational use occurs in the Mexican Pocket area, above Sterling Canyon, and along the Forest Roads (FR's) 237 and 535. A substantial number of non-system (social) trails are located south of Kachina Village. These trails are often poorly located and receive no maintenance. Some social trails have resulted in conflicts between users. Forest Service trail budgets do not allow for maintenance of all the current system trails and there is no maintenance of unofficial trails.

The desired condition is a well designed system of roads and trails that balances road and trail systems with demands for access for recreation and fire suppression, as well as overall watershed productivity and long-term needs for wildlife populations near urban areas.

Need to reverse deleterious trends in recreation, road, and trail use. Need to reduce road densities. Need to change camping uses in highly impacted areas. Need to locate a road and trail system that meets desired conditions.

Wildlife Movement: There is an important wildlife travel corridor within the project area that provides an important connection between the canyons in the Kachina Village area and Woody Ridge. This corridor is impacted by high numbers of camping sites and is at risk of crown fire, which could severely impact the corridor for several decades. The desired condition is to maintain the ability of wildlife to use this travelway.

Need to reduce the risk of, and potential for, catastrophic wildfire around this corridor. Need to change from moderate to high levels of human disturbance to wildlife to low to moderate levels. Need to undertake a more active management of roads and dispersed recreation.

Goshawks: A northern goshawk Post Fledgling-Family Area (PFA) is located within the project area. Most of the project area provides either PFA or foraging habitat for the goshawk. The desired condition is to maintain habitat for goshawks per the appropriate Forest Plan standards and guidelines. The existing forest structure is different from the desired forest structure described in the Forest Plan. Currently the PFA is lacking the number of large trees recommended for PFA's in the Forest Plan.

Need to improve northern goshawk habitat by creating a better balance of forest structures. See additional information under plant and animal diversity paragraph above.

Mexican Spotted Owls: Forest Plan standards and guidelines for the Mexican spotted owl apply where habitat for the Mexican spotted owl has been designated or defined as "restricted" for this species. The desired condition is to maintain occupied habitat and to progress restricted habitat toward conditions suitable for nesting roosting. The desired condition is to lessen the risk of catastrophic fire moving into these habitats from surrounding areas.

Need to retain some portions of the project area as dense, multi-storied forest to maintain current Mexican spotted owl habitat. Need to reduce the potential for loss of Mexican spotted owl habitat due to catastrophic wildfire to lessen the possibility of losing the habitats and the species in this area. See the fire risk and fire potential discussion above for more information.

Riparian: Current conditions at Kelly Seep include bare ground, erosion, little plant reproduction or diversity. The desired condition is lush vegetation with little bare ground, good plant reproduction and diversity, and water that percolates into the soil rather that running over the ground. Riparian habitats are very important for plant, bird, and animal species dependent on these wet environments.

Need to restore the Kelly Seep riparian site.

Public Involvement

The Council on Environmental Quality (CEQ) defines scoping as "...an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a Proposed Action'' (40 CFR 1501.7). Among other things, the scoping process is used to invite public participation, to help identify public issues, and to obtain public comment at various stages of the EIS process. Although public participation is to begin early, it is really an iterative process that continues until a decision is made. In addition to the following specific activities, the Kachina Village Forest Health Project has been listed on the Coconino National Forest Schedule of Proposed Actions since December 15, 2000, which is mailed to approximately 500 persons, organizations, and agencies. The Proposed Action was mailed to approximately 100 addresses. To date, the public has been invited to participate in the project in the following ways.

Notice of Intent (NOI): A Notice of Intent to prepare an EIS was published in the Federal Register on March 9, 2001 (PRD 31).

Public Meetings: Public meetings were held in February, March, and April of 2001 to provide project area information, develop the desired future condition, and discuss local concerns and interests that should be addressed in the Kachina Village Forest Health Project analysis. Over 50 people attended the meetings.

Public Mailing: In June 2001, a letter providing information and seeking public comment was mailed to approximately 100 individuals and groups. This included Federal and state agencies, Native American groups, municipal offices, businesses, interest groups, and individuals. A total of 12 responses to this initial mailing were received (PRD 93, Proposed Action Mailing List).

Local News Media: Announcements regarding the project were printed in the *Arizona Daily Sun* on March 30, 2001 (PRD 53).

Meetings with Agencies, Communities, Native Groups, and Others: In October 1999, a field trip involving the Grand Canyon Trust (GCT), U.S. Fish and Wildlife Service (USFWS), Native American Enterprises, and the Arizona Game and Fish Department (AGFD) reviewed proposed projects for the 2001 fiscal year. Six interdisciplinary team meetings occurred in February, March, and April 2001, involving the Coconino Natural Resources Conservation District, the Southwest Forest Alliance, USDA Forest Service Rocky Mountain Research Station, AGFD, the Ecological Restoration Institute (ERI) of Northern Arizona University (NAU), the USFWS, the Grand Canyon Forests Foundation, the GCT, Flagstaff Fire Department, the Society of American Foresters, the Highlands Fire Department, and the Arizona State Land Department. The purpose of these meetings was to work toward the Proposed Action through development of a desired future condition. Two field trips in April 2001 with the Grand Canyon Forest Partnership discussed wildlife habitat, specifically cover and movement corridors, thinning to enhance yellow pines, roads, and fuels reduction. In April 2001, an open house was held for the residents of Kachina Village to identify issues and concerns related to the project. Also in April 2001, AGFD, the Grand Canyon Forest Foundation, and the ERI of NAU made a Mexican spotted owl field visit. In May, July, and August 2001, the GCFP held meetings to review the planning process and recommendations to the Forest Service. A field trip in July 2001 with AGFD was conducted to discuss the proposed treatments in relation to game species habitat. Two field trips in September 2001 with AGFD and USFWS discussed fuels treatments within Mexican spotted owl PAC's.

Other Sources: Public comment received to the Flagstaff/Lake Mary Ecosystem Analysis in response to "Ideas Change for the Flagstaff/Lake Mary Analysis" were reviewed by team members when developing the Proposed Action.

Issues

Significant issues for the Kachina Village Forest Health Project were identified through public scoping. Similar issues were combined into one statement, where appropriate. The following issues were determined to be significant and within the scope of the project decision. These issues are addressed in the Proposed Action and alternatives to the Proposed Action. Additional concerns were considered but determined to be non-significant in relation to the current project. These concerns are discussed separately in "Significant and Non-Significant Issues," located in Appendix A, "Scoping Comment Analysis."

Issue 1: 16-Inch Diameter Limit Issues

Cutting trees greater than 16-inch diameter would affect future old-growth in the area, resulting in fewer acres being able to qualify as old-growth forest structure in the future.

Issue 2: 18-Inch Diameter Limit Issue

All project objectives could be met with an 18-inch diameter limit and request that a quantitative analysis be provided.

Issue 3: "Intensive Zone"

The Proposed Action does not reduce fuels sufficient to protect the immediate wildland-urban interface. An "intensive treatment zone" around private land is requested for evaluation.

Issue 4: Lighter Thinning Methods

Thinning north of Kelly Canyon as described in the Proposed Action goes beyond what is needed to reduce fire risk. A lighter treatment of 60 to 120 basal area and a 9-inch thinning limit (where a temporary road is needed) is requested for evaluation.

Issue 5: Road Issues

Temporary roads lead to increased soil compaction, transport of exotic weeds, and have long-lasting impacts on forest structure, therefore, we request that no new temporary roads be created even if only for the duration of the project.

Issue 6: Mechanized Equipment

Mechanized equipment and excessive thinning will increase soil compaction and cause disturbance to wildlife in areas south of Kelly Canyon. The area south of Kelly Canyon should only be treated with hand thinning and was requested for evaluation.

Other Concerns Raised by the Public

Following public scoping, other questions, concerns, and comments related to various resource areas were raised and considered in the analysis of significant issues. However, they were determined to be non-significant issues in that they would not drive alternatives. All comments received were addressed. There are three sections of Appendix A that show how various comments, questions, concerns, and issues were addressed. Some have already been addressed through other processes, in the Forest Plan, or their resolution is beyond the scope of this project (see Appendix A).

Applicable Laws and Executive Orders

Shown below is a partial list of Federal laws and executive orders pertaining to project-specific planning and environmental analysis on Federal lands. While most pertain to all Federal lands, some of the laws are specific to Arizona. Disclosures and findings required by these laws and orders are contained in Chapter 2 of this EIS.

- Multiple-Use Sustained-Yield Act of 1960
- National Historic Preservation Act of 1966 (as amended)
- Wild and Scenic Rivers Act of 1968, (as amended)
- National Environmental Policy Act (NEPA) of 1969 (as amended)
- Clean Air Act of 1970 (as amended)
- Endangered Species Act (ESA) of 1973 (as amended)
- Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (as amended)
- National Forest Management Act (NFMA) of 1976 (as amended)
- Clean Water Act of 1977 (as amended)
- American Indian Religious Freedom Act of 1978
- Archeological Resource Protection Act of 1980
- Cave Resource Protection Act of 1988
- Executive Order 11593 (cultural resources)
- Executive Order 11988 (floodplains)
- Executive Order 11990 (wetlands)
- Executive Order 12898 (environmental justice)
- Executive Order 12962 (aquatic systems and recreational fisheries)
- Executive Order 13186 (Migratory Bird Treaty Act)

Chapter 2 • Alternatives

Introduction

This chapter describes and compares the alternatives considered by the Forest Service for the Kachina Village Forest Health Project. It includes a discussion of how alternatives were developed; an overview of mitigation measures, monitoring and other features common to all alternatives, a description, visual simulations, and map of each alternative considered in detail; and a comparison of these alternatives focusing on the significant issues. Alternative A is identified as the preferred alternative. Chapter 2 is intended to present the alternatives in comparative form, sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public (40 CFR 1502.14).

Some of the information used to compare alternatives at the end of Chapter 2 is summarized from Chapter 3, "Affected Environment and Environmental Consequences." Chapter 3 contains the scientific basis for establishing baselines and measuring the potential environmental consequences of each of the alternatives. For a full understanding of the effects of the alternatives, readers will need to consult Chapter 3.

Alternative A Development Process

The development of alternatives for the Kachina Village Forest Health Project began with the development of the Proposed Action (Alternative A). This alternative was crafted by the Forest Service Interdisciplinary Team (IDT) after several months of collaboration and work with members of the public and the Grand Canyon Forests Partnership. The project focus is to improve forest health conditions focusing on the Flagstaff Wildland-Urban Interface (WUI). For the City of Flagstaff and the surrounding satellite communities, the Forest Service has had a definition of the WUI in the Coconino National Forest Plan and a map of the interface that has been in use for years. The Fire Management Area Zone (FMAZ) Map shows that all but a small area south of James Canyon are within the WUI. In the Forest Plan, there is guidance on the size and scale of the WUI. On page 93, the Plan states, "The urban interface is defined as an area up to 10 miles long in a southwesterly direction from urban areas."

Wildland-Urban Interface Areas—Background Information

The Council of Western State Foresters and the Forest Service have adopted the following definition of wildland-urban interface. A "Wildland-Urban Interface is where humans and their development meet or are intermixed with wildland fuels" (Teie and Weatherford, 1998: 11-12).

There are four different wildland-urban conditions:

- An **Interface Condition** is a situation where structures abut wildland fuels. There is a clear line of demarcation between the structures and the wildland fuels along roads or back fences. Wildland fuels do not continue into the developed area.
- An **Intermix Condition** is a condition in which structures are scattered throughout a wildland area. There is no clear line of demarcation. The wildland fuels are continuous outside of and within the developed area.
- An **Occluded Condition** is a situation normally within a city in which structures abut an island of wildland fuels. There is a clear line of demarcation between the structures and the wildland fuels along roads or back fences.
- A **Rural Condition** is a situation in which scattered small clusters of structures are exposed to wildland fuels. There may be miles between these clusters.

The prioritization of the Flagstaff Urban Interface has relied on the Forest Service and local fire department personnel to describe areas that should be treated to improve forest health, leading to decreased wildfire potential. In the Cohesive Strategy, Laverty et al. (2000:17) states, "The first priority for restoration will be the millions of acres already roaded and managed landscapes that are in close proximity to communities." Laverty (2000: 14) also sets the following three priorities:

- **Wildland-Urban Interface**. The WUI areas include those areas where flammable wildland fuels are adjacent to homes and communities.

- **Readily Accessible Municipal Watersheds**. Water is the most critical resource in many western states. Watersheds impacted by uncharacteristic wildfire effects are less resilient to disturbance and unable to recover as quickly as those that remain within the range of ecological conditions characteristic of the fire regime under which they developed.
- **Threatened and Endangered Species Habi**tat. The extent of recent fires demonstrates that, in fire-adapted ecosystems, few areas are isolated from wildfire. Dwindling habitat for many threatened and endangered species will eventually be impacted by wildland fire. The severity and extent of fire could eventually push declining populations beyond recovery.

Development of Alternatives

The IDT used information from public scoping, including the significant issues identified for the project (see Chapter 1), in conjunction with the field-related resource information, to formulate different alternative themes. Based on these themes, the IDT then assigned different potential treatment prescriptions to land units to create the various alternatives. **The alternatives for the Kachina Village Forest Health Project are differentiated primarily by a limit on the size of tree to be thinned, the intensity of the treatments proposed in thinning units, and the miles of temporary road.** The Proposed Action (Alternative A) and each action alternative presented in this EIS provide a different response to the significant issues. One alternative may respond to more than one issue. Each action alternative is also designed to meet the stated purpose and need for the Kachina Village Forest Health Project and the project-specific desired future conditions.

Each action alternative represents a site-specific proposal developed through intensive interdisciplinary evaluation of current and desired conditions based on field verification. Unit identification and design also made use of high-resolution topographic maps, aerial photos, and a large quantity of resource data available in geographic information system (GIS) format.

Items Common to All Action Alternatives

Many items in the Proposed Action (Alternative A) also occur in all action alternatives. The **action alternatives are differentiated by the size of the trees to be thinned, changes in intensity of thinning prescriptions, and the use of temporary roads**. The following items from the Proposed Action (Alternative A) are common to Alternatives A, C, D, and E and would not occur under Alternative B (No Action). Refer to the Purpose and Need section of Chapter 1 to see the reasons why these items are proposed.

Administrative and Strategic Direction for the Project Area

1. **Follow all Coconino National Forest Plan Standards and Guidelines and Apply Mitigation Measures**

   This is the application of the Coconino National Forest Plan and subsequent amendments, including all guidelines for Mexican spotted owl, northern goshawk, Management Indicator Species, Best Management Practices for water and soil, and archeological site protection. Refer to "Forest Plan Consistency" and "Monitoring" found later in this chapter for more detail.

2. **Retain all existing mature ponderosa pine trees or old "yellow-barked" trees.** Temporary road or landing locations to achieve removal objectives will avoid large diameter trees, where possible.

3. **Prioritize Project Implementation**

   Project implementation will treat stands adjacent to communities first, then progressing south thereafter.

4. **Involve the Public**

   Involve individual property owners, fire protection districts, and communities in the proposed treatments. Currently, Highlands Fire Department is actively working in the communities of Kachina Village and Forest Highlands, conducting thinning projects and increasing public awareness of fire prevention techniques.

5. **Encourage Research and Monitoring**

   The Arizona Game and Fish Department, Northern Arizona University, and the USDA Forest Service Rocky Mountain Research Station have expressed interest and discussed preliminary actions for research in the project area. Possible research studies may include Mexican spotted owl studies to examine the effects of fuel reduction treatments, black bear, turkey, antelope, Abert squirrel, and songbird studies to evaluate the effects of the project, and further studies by Northern Arizona University to evaluate and compare the ongoing research and monitoring of adaptive management strategies for the Grand Canyon Forests Partnership Projects. See "Monitoring" later in this chapter for more details.

6. **Apply thinning systems to sites as appropriate**

   Thinning systems will include mechanized equipment resulting in the commercial removal of trees. Hand felling will also be used for commercial thinning, as well as public firewood use. Some trees will be piled and burned on site.

Reducing Fire Potential – Improving Forest Ecosystem Health – Fuels and Vegetation Management

(See Figure 2, "Fuels Treatment Alternatives A, C, D and E" and Figure 3, "Thinning Treatments Common to All Action Alternatives A, C, D and E" for maps related to the following items)

7. **Broadcast Burning and Slash Treatment**

   Activity-generated slash resulting from thinning will be treated through machine piling or by hand. Existing large logs and logs created will be retained. The majority of slash from thinning will be piled in a manner that minimizes soil disturbance. Some small coarse woody debris will be retained on the ground to meet Best Management Practices for soil and watershed health. Nearly 80 percent of the slash created will be treated. The slash piles will be burned approximately 1 to 2 years following thinning. Public firewood will be made available from slash piles, where feasible. Broadcast burning will occur after thinning is completed. Best Management Practices for soil and watershed management will be employed to minimize soil disturbance and the spread of invasive and noxious weeds. Broadcast burning will begin adjacent to the communities and progress south thereafter. Burns will occur over a number of years with different portions of the project area burned in a given year. All national forest lands within the project area, excluding the canyons, are proposed for broadcast burning in the following priority:

   - First priority is the area north of Kelly Canyon and along the Highway 89A Corridor;
   - Second priority is the area between Kelly and James Canyons; and
   - Third priority is the area south of James Canyon.

8. **Thinning from Below: Mexican Spotted Owl (MSO) Protected Activity Centers (PAC's)**

   Four hundred fifty-six acres of thinning from below is proposed for habitat within Mexican spotted owl PAC's. A special team, including U.S. Fish and Wildlife Service (USFWS) personnel, Arizona Game and Fish Department (AGFD) habitat specialists, U.S. Forest Service (USFS) wildlife biologist, and fire management practitioners, are visiting all stands within MSO PAC's and recommending site-specific treatments to lessen fire potential and risk. Specifics for treatments are located in the Project Record File. All stands are located on slopes less than 30 percent. Proposed management includes thinning trees less than 9-inches dbh, broadcast burning, and road access management to reduce fire risk. The key to implementation of site-specific thinning includes layout and assistance during thinning by the USFWS, USFS, and AGFD personnel.

9. **Wildlife Movement Corridor**

   The AGFD and USFS wildlife biologists identified the location of this wildlife movement corridor (143 acres) based on historical knowledge of the area. The treatment within the corridor will include light thinning within the drainage and the area 200 yards on either side of the drainage located in these two stands. The remainder of the stand will be treated with

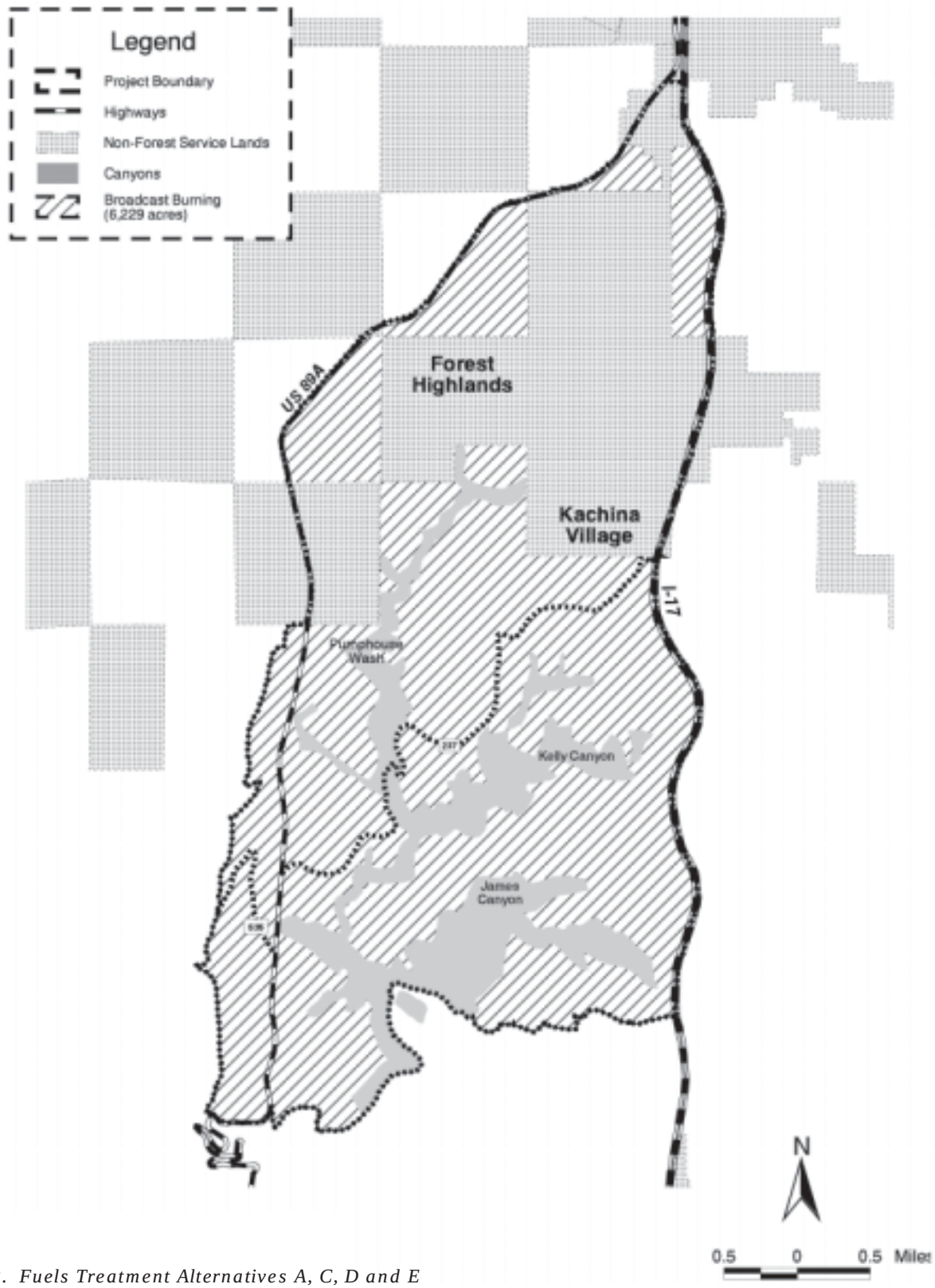

Figure 2. Fuels Treatment Alternatives A, C, D and E

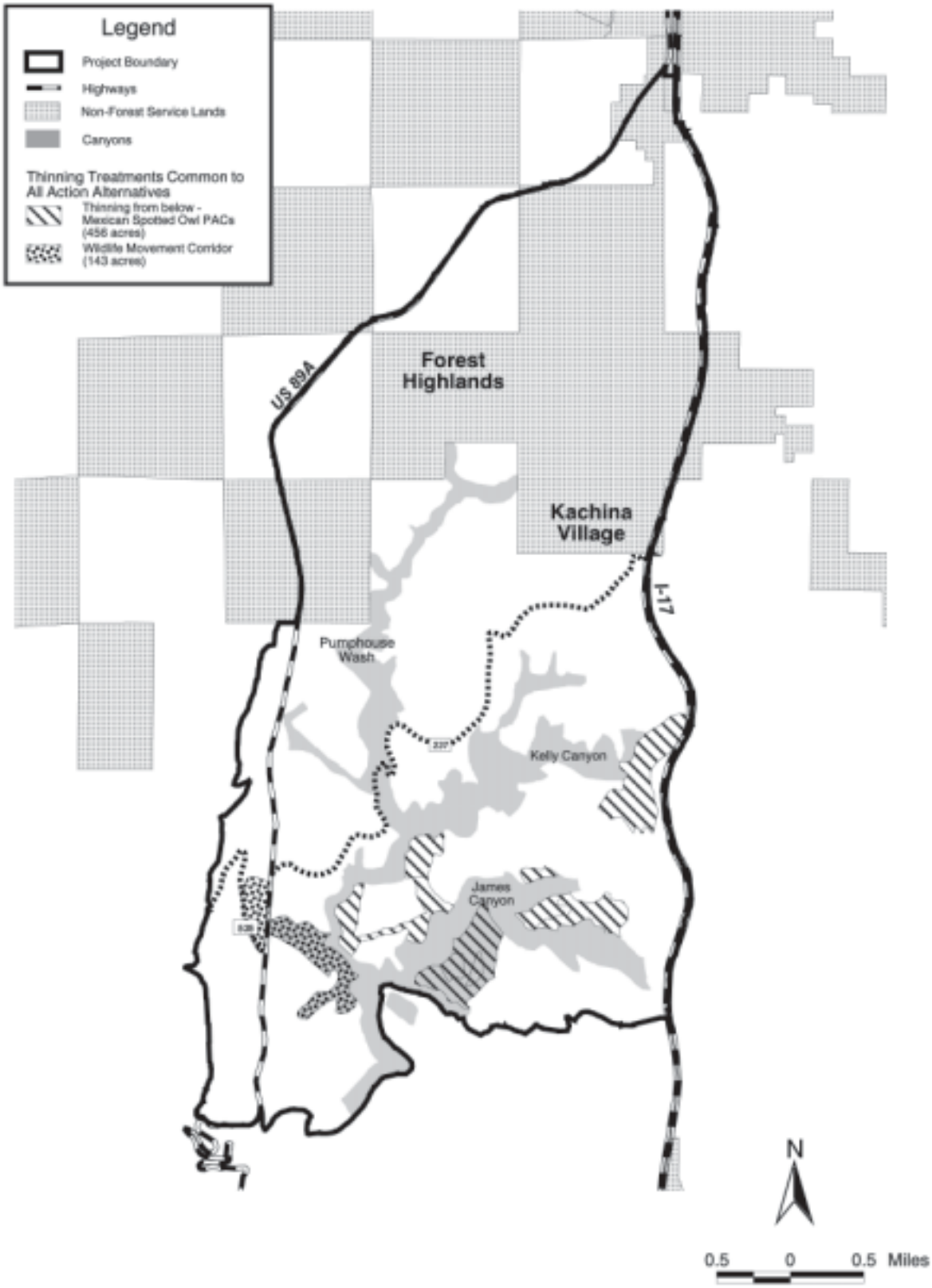

Figure 3. Thinning Treatments Common to All Action Alternatives A, C, D and E

a variable thinning. The site-specific layout will include assistance from the AGFD and USFS wildlife biologists.

Reducing Fire Risk – Balancing Human Influences, Fire Occurrence, Wildlife Habitat, and Watershed Health Through Management of Recreational Uses and Access

(See Figure 4, "Management of Recreational Uses Alternatives A, C, D and E" and Figure 5, "Open Forest Roads" for maps related to the following items)

10. Camping and Campfires

Camping and campfires will be prohibited in the area north of Kelly Canyon and west of Pumphouse Wash to one half mile on the west side of Highway 89A, except in designated areas. Camping and campfires will be prohibited in areas of close proximity to Kachina Village and Forest Highlands. Camping and campfires will also be prohibited on the first one half mile of the FR 535 as it departs Highway 89A.

Designated camping is proposed along the FR 237. Camping will be limited to camping in designated campsites only. Selection of designated campsite locations will be determined from site-specific inventory and be incorporated into the layout of proposed thinning treatments. Camping in the designated sites will be allowed within a 50 to 100 foot radius of a marked post.

11. Trails

Forest Service system non-motorized trails are proposed south of Forest Highlands and Kachina Village. Approximately 7 miles of trails are proposed south of Kachina Village to replace a social trail system in the area. Any newly designated trail access from Kachina Village and Forest Highlands will be determined with the layout and design of a non-motorized trail system for the area. One new trailhead is proposed near the existing ADOT yard on Highway 89A. An existing social trail from Forest Highlands into the Griffith Spring area will be converted to a Forest Service system trail. Trails will have additional visual and Recreation Opportunity Spectrum (ROS) objectives that will be included in thinning prescriptions and overall project design.

12. Mexican Pocket Management

Mexican Pocket will be designated for day-use only, with no camping or campfires. To continue to provide access to a popular area, a 2-mile loop trail is proposed to provide hiking to the edge of Pumphouse Canyon and to connect the Oak Creek Vista Overlook with a small trailhead constructed near the ADOT yard.

13. Passenger Car Roads (Level 3 Roads)

Forest Roads 237 and 535 will be maintained as Level 3 roads, thereby providing approximately 7 miles of passenger car roads. FR 237 will continue to be the primary access road to the Kachina Village Forest Health Project Area, in addition to important area access for wildfire fighting efforts.

14. High-Clearance Vehicle Roads (Level 2 Roads)

Approximately 8.5 miles of road will be maintained as Level 2 roads in the project area (See Figure 5). The proposed road access plan provides good administrative access for firefighting and provides for the best arrangement and location of roads to balance wildfire risk (human access) and recreation experience. Roads not shown on the open-road system will be converted to trails, obliterated, or gated for administrative use. Primary administrative use is fire access.

15. Riparian Restoration Project at Kelly Seep (Located Near Kelly Canyon)

The area around Kelly Seep will be fenced and structures removed to improve riparian habitat conditions.

Forest Plan Consistency

All alternatives, including the Proposed Action, are consistent with the Coconino National Forest Plan. All applicable forest-wide and land use designation standards and guidelines have been incorporated. The Forest Service uses many mitigation and preventive measures in the planning and implementation of land management activities. The application of these measures begins during the planning and design phases of a project. Additional direction comes from the Regional Guide and applicable Forest Service manuals and handbooks.

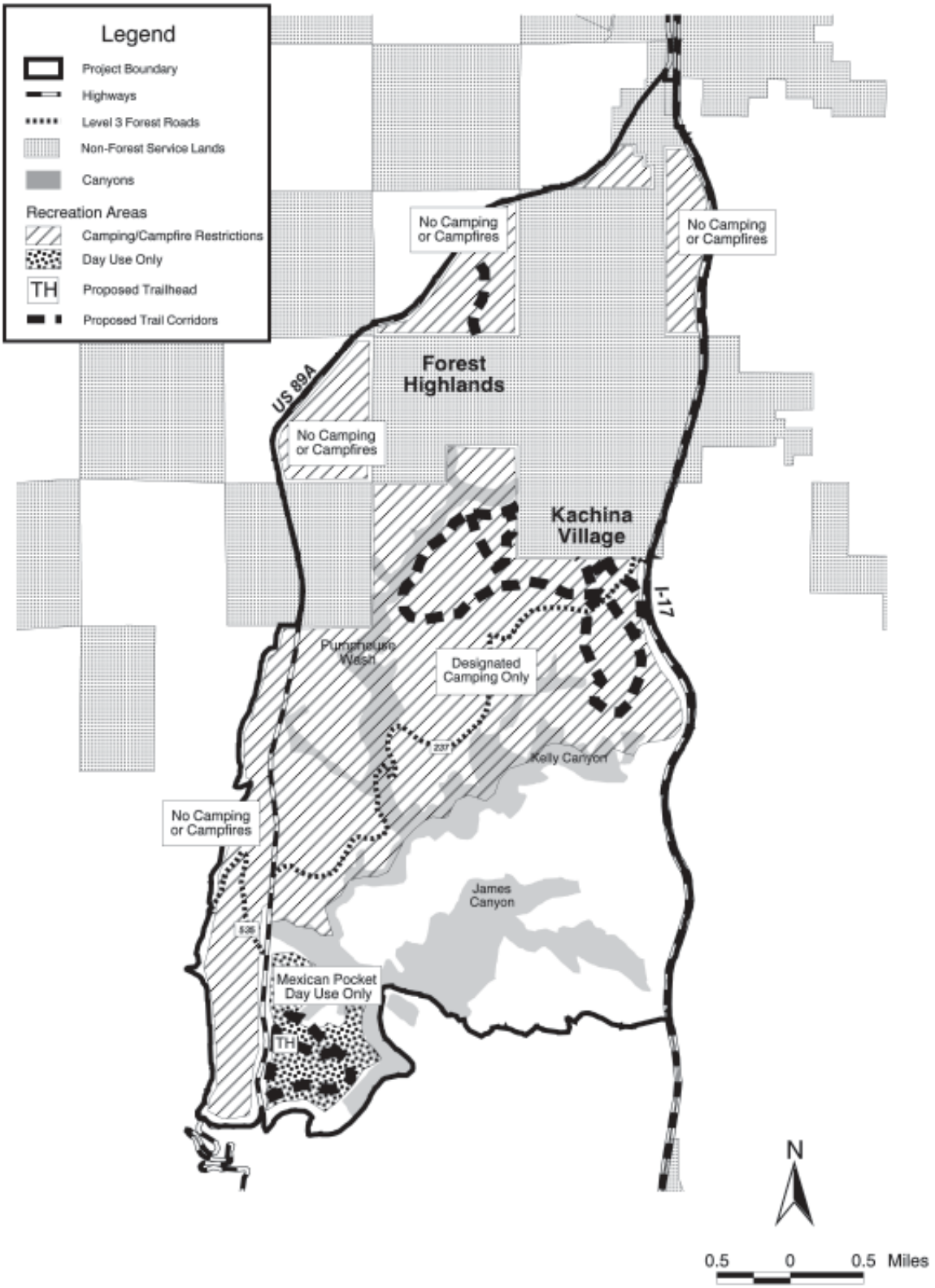

Figure 4. Management of Recreational Uses Alternatives A, C, D, and E

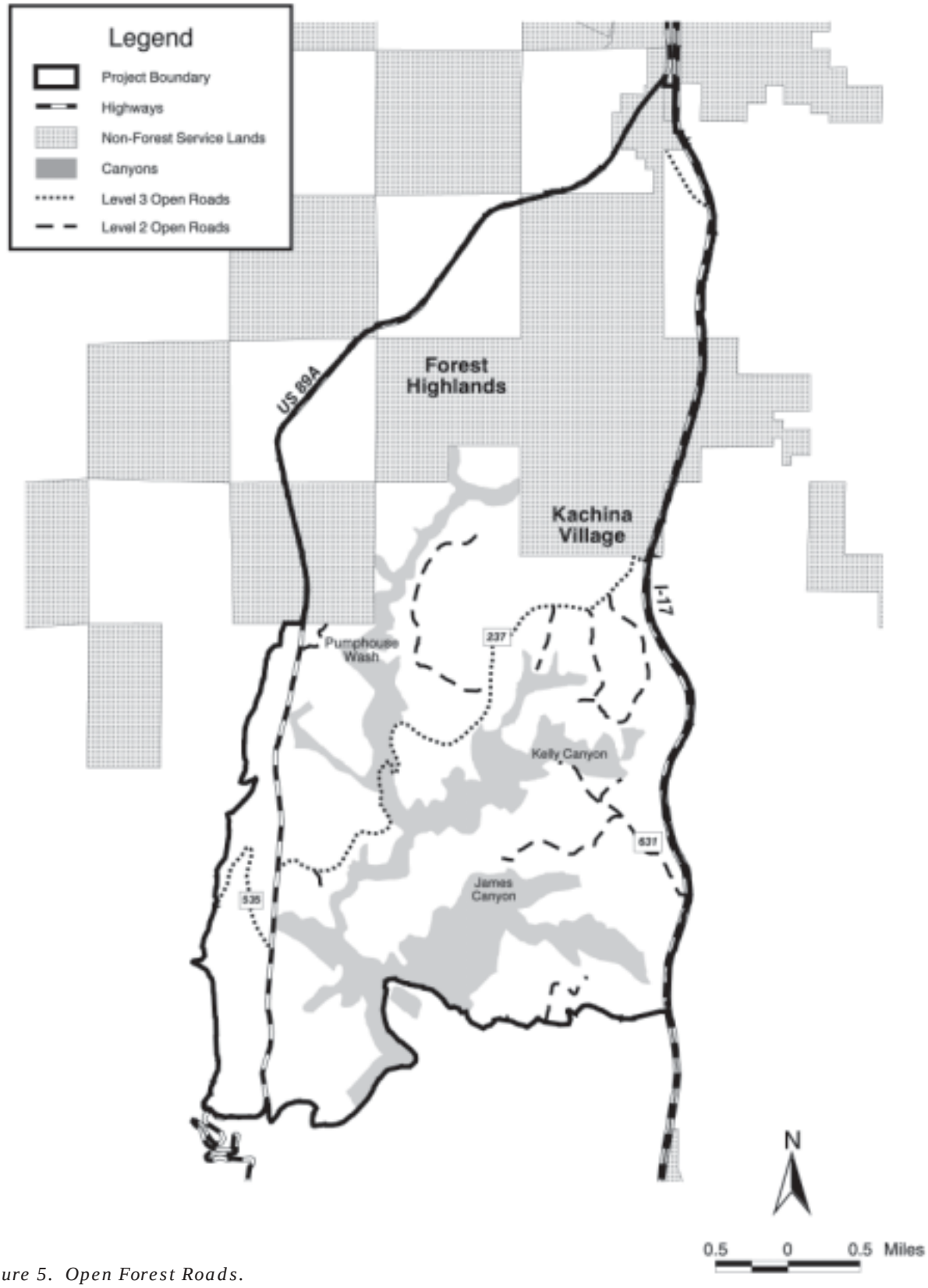

Figure 5. Open Forest Roads.

Not all desired conditions in the Forest Plan can be achieved with a single, on-the-ground action. Often many actions are necessary in order to meet desired conditions identified by management direction. For example, this project has alternatives that make progress toward the desired distribution of tree sizes and ages described for northern goshawk habitat. We do not plan to change the structure of the forest stands in one single treatment in order to meet those guidelines in this area.

Appendix E highlights some of the key directions from the Forest Plan (primarily from Chapter 4, "Forest-wide Standards and Guidelines"). Further direction is located in Forest Plan as changed by Amendment 11. (Also see, "Project-Specific Mitigation" that follows.)

Project-Specific Mitigation

The analysis documented in this EIS discloses the possible environmental consequences that may occur from implementing the actions proposed under each alternative. Measures have been formulated to mitigate or reduce these impacts. These measures were guided by the direction from the Forest Plan and the interdisciplinary team (IDT) as they developed the project.

IDT specialists use on-the-ground inventories, computer (GIS) data, and aerial photographs to prepare reports. Resource specialists include their concerns in their reports and then describe how the concerns can be mitigated, if not completely avoided, in the design of each treatment unit or road segment. These reports may be found in the planning record. Resource concerns and mitigation measures may be further refined during the final design work, when specialists have one more opportunity to revise their recommendations.

Applicable Forest Plan standards and guidelines and Best Management Practices (BMP's) used to meet the requirements of the Clean Water Act and project-specific mitigation measures are identified in these reports. The following items are mitigation measures that will be employed for the Kachina Village Forest Health Project. Though most of the following mitigation items are common to all action alternatives, there are a few associated with Alternative E that are different. These exceptions are noted in the text.

Soil and Watershed Protection

A Best Management Practice (BMP) is "a practice or a combination of practices that is determined by a state (or designated area-wide planning agency), after problem assessment, examination of alternative practices, and appropriate public participation, to be the most effective and practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals ("Guidelines for Using Best Management Practices" (FSH 2509.22))." Authority and guidance to prescribe and implement BMP's is defined in FSM 2501, 2530, FSH 2509.22, and the Forest Plan.

BMP's with numbers (e.g., 24.1 Timber Harvest Unit Design) are from the Soil and Water Conservation Practices Handbook. BMP's without numbers (e.g., Mechanical Harvesting Restriction) are site and activity-specific BMP's designed to minimize nonpoint source pollutants.

BMP's are located in the project record file (PRD137c) and will be reviewed by project implementation personnel.

Wildlife and Sensitive Species Habitat Protection

Bald Eagle

- In the potential winter roost area, snags and large yellow pine trees will have the duff raked away from the tree bases.
- Implement a 300-foot radius buffer around known bald eagle winter roosts (Coconino National Forest Plan, 1987, p. 123), or as amended.
- Mandatory Impact Minimization Measures will be used to protect bald eagles (USDI Fish and Wildlife Service 2001) if it is later determined that the potential winter roost site, or any other area within the project boundary, is used for roosting by bald eagles.
- There will be no project activities within 1/4 mile of known bald eagle winter roost areas between October 15 and April 15.

Mexican Spotted Owl (MSO)

- No treatment activities will occur within PAC's during the breeding season (March 1 to August 31).
- Microhabitat monitoring will be conducted per protocol.
- Additional mitigation for MSO is in the project record file (PRD151).

Peregrine Falcon

- Activities, including public use, are prohibited in the vicinity of occupied peregrine falcon nesting habitats between March 1 and August 15 (Forest Plan page 64-1). No treatments will occur on location/sites 354/29 and 31 and the southern half of location/sites 354/23 and 24 from March 1 to August 15. This seasonal restriction applies unless falcon habitat is determined to be unoccupied. Trails will be designed to avoid nesting areas.

Northern Goshawk

- Thinning treatments will not occur within or near nesting areas during the breeding season (March 1 through September 30).
- The Coconino National Forest Plan (1987 as amended) standards and guidelines will be followed regarding broadcast burning.
- Recreational trails that traverse nesting areas will be closed. Access that will allow people to travel into nesting areas will be discouraged.

Other Raptors

- Buffers for nest and roost sites will be implemented according to the Coconino National Forest Plan (1987 as amended, p. 123-124) standards and guidelines.

Turkey Nesting

- Thinning and broadcast burning will not occur from April 15 through June 30 within turkey nesting and brood sites within location 368/sites 7, 9, 10, 32, 33, 36, 37, and 38. Duff and debris will be raked away from the base of roost trees prior to broadcast burning. Also within these stands, the wildlife biologist and burn boss will coordinate, in the field, whether or not to conduct spring burning in these sensitive areas.

Plants

- To reduce the impacts on rare and sensitive plants, thinning slash and burn lines will not be placed within plant populations. Appropriate firing techniques will be used to minimize the effect of burning on known populations.
- Prescribed fire control lines and temporary roads will avoid known populations of sensitive plant species.
- Surveys for TE&S plant species will be conducted prior to trail construction. If sensitive plant species are found, rerouting of trails will be required.
- Native perennial species or annual rye grass seeds will be used where re-seeding of grasses and herbaceous vegetation is needed after ground disturbing activities. Sterile non-native species or non-seeding methods, such as weed-free straw, may be necessary for sites where annual rye grass persists. Seed mixes containing seeds of non-native *Penstemon spp*. will be avoided.
- Equipment will be cleaned prior to entering the project area to avoid introduction or transfer of invasive and noxious weeds. Within the project area, equipment will be cleaned prior to leaving areas infested with invasive and noxious weeds. Entrance and exit routes from Interstate 17 and Highway 89A will include hand tool treatment of noxious weeds. Known populations of knapweed and bull thistle will be marked for avoidance.

Yellow Pines and Other Mature Trees

- Slash piles will not be placed near large yellow pines to avoid damage during burning. This would be especially important in bald eagle winter roost areas, turkey summer and winter ranges, and protected or restricted MSO habitat.
- Burn damage to large mature trees will be avoided. Burning techniques will protect mast-producing trees (i.e. large alligator juniper, large pine, and oak), and turkey roost trees throughout the project area. Burning techniques will minimize heat effects to the feeder roots and cambiums of mature trees.

- Old trees will have duff raked away from the bases where high litter depth layers (greater than 6 inches) may result in girdling and mortality. The Prescribed Burn Monitoring Report and Information (Randall-Parker and Miller 1999) will guide our actions.

Gambel Oak

- Gambel oak will be retained. Burn plans will mitigate oak loss through the removal of large material, raking duff from the base of oaks, and avoidance of slash piles near oaks.

Snags and Logs

- Snags will be lined prior to broadcast burning. Slash piles will be placed away from snags.
- Loss of large logs will be minimized through ignition techniques and possibly fire-lining. The timing of prescribed burning (spring burning) may also reduce the loss of logs.
- Trees that are converted to snags or logs will be monitored.

Recreation

- No slash piling in dispersed camping sites.
- No log landings in dispersed camping sites.
- No disruptive restoration activities on heavily-used holiday weekends such as Memorial Day, Fourth of July, or Labor Day.

Visual Management – Coordination with Layout and Design of stands prior to marking

- Adjust unit boundaries to avoid straight edges around units. Develop marking prescriptions, which “feather” the edges of units. Look for opportunities to define unit boundaries with natural features such as canyon edges or drainages and avoid using roads or fence lines as unit boundaries when those features are straight. Refer to visual simulations for reference.

  Apply above mitigation especially to units at the upper elevations of the project, and to units whose boundaries are visible from areas of concern such as from Highway 89A and Interstate 17.

Monitoring

Monitoring activities can be divided into forest plan monitoring and project-specific monitoring. The National Forest Management Act requires that national forests monitor and evaluate their forest plans (36 CFR 219.11). Chapter 6 of the Forest Plan includes the monitoring and evaluation activities to be conducted as part of forest plan implementation. There are three categories of forest plan monitoring:

- **Implementation monitoring** is used to determine if the goals, objectives, standards, guidelines, and practices of the forest plan are implemented in accordance with the forest plan.
- **Effectiveness monitoring** is used to determine if the forest plan standards, guidelines, and practices, as designed and implemented, are effective in accomplishing the desired result.
- **Validation monitoring** is used to determine whether the data, assumptions, and estimated effects used in developing the forest plan are correct.

Effectiveness and validation monitoring are not typically done as a part of the project implementation. Implementation monitoring and any additional project-specific monitoring are, however, important aspects of the project. Though most of the following mitigation items are common to all action alternatives, there are a few associated with Alternative E that are different. These exceptions are noted in the text.

Routine Implementation Monitoring

Routine implementation monitoring assesses if the project was implemented as designed and if it complies with the Forest Plan. Planning for routine implementation monitoring began with the preliminary design of the Kachina Village Forest Health Project.

Routine implementation monitoring is a part of the administration of all project contracts. They monitor performance relative to contract requirements. Input by resource staff specialists, such as wildlife biologists, soil scientists, hydrologists, and engineers, is regularly requested during this implementation monitoring process. These specialists provide technical advice when questions arise during project implementation.

The Coconino National Forest staff conducts an annual review of BMP implementation and effectiveness. The results of this and other monitoring are summarized in the Coconino National Forest Annual Monitoring and Evaluation Report. This report provides information about how well the management direction of the forest is being carried out. It also measures the accomplishment of anticipated outputs, activities, and effects.

The Kachina Village Forest Health Project will include the following implementation monitoring:

- **Alternatives A, C, and D: Thinning from Below, South of Kelly Canyon.**

  Site-specific implementation, such as the layout of cover, marking, and thinning, will include assistance from the Arizona Game and Fish Department and the USFS wildlife biologists. The monitoring objective will be to assure the sites include cover patches. The sites will include 25 percent cover patches in patches no larger than 1 acre. The district wildlife biologist along with timber staff will assume responsibility for the completion of the task. Alternative E does not include cover clumps.

- **All Action Alternatives: Thinning from Below, MSO PAC's**

  The key to implementation of site-specific thinning includes layout and assistance during thinning by U.S. Fish and Wildlife Service, USFS, and Arizona Game and Fish Department personnel. Recommendations for thinning and prescribed burning are located in the Project Record File (PRD 117). The objective of the monitoring is to reduce fire potential within MSO PAC's, following recovery guidelines. Fuels specialists and the district wildlife biologist will be responsible for completing the task.

- **All Action Alternatives: Wildlife Movement Corridor**

  The site-specific layout will include assistance from the Arizona Game and Fish Department and USFS wildlife biologists. The monitoring objective is to assure the site includes adequate cover within the movement corridor. The district wildlife biologist along with the timber staff will assume responsibility for completion of the task.

- **All Action Alternatives: Herbaceous Understory Recovery**

  The Annual Operating Instructions (AOI) for grazing allotments will be adjusted as needed to allow for recovery of naturally occurring herbaceous communities. Range conservationists will conduct monitoring following both thinning and burning treatments. Monitoring will be conducted via observations to determine readiness for livestock use. These observations will include species maturity (seed heads) and abundance. Grass species, including Arizona fescue (*Festuca arizonica*), mountain muhly (*Muhlenbergia montana*), and squirrel tail (*Sitanion hystrix*) will be the key species used in these observations. Invasive and noxious weed monitoring will occur during these observations to detect changes in distribution and/or abundance.

Project-Specific Effectiveness Monitoring

The purpose of effectiveness monitoring is to determine the efficacy and usefulness of specific design features or mitigation measures in protecting natural resources.

Administrative and Strategic Direction for the Project Area

The Arizona Game and Fish Department, Northern Arizona University (NAU), and the USDA Forest Service Rocky Mountain Research Station have expressed interest and discussed preliminary actions for research within the project area. This research and monitoring is encouraged. Possible research studies may include MSO studies to examine the effects of fuel reduction treatments, black bear, turkey, antelope, Abert squirrel, and songbird studies to evaluate the effects of the project, and further studies by NAU to evaluate and compare the ongoing research and monitoring of adaptive management strategies for the Grand Canyon Forests Partnership projects.

At the time the Draft EIS was prepared, three monitoring proposals were submitted to the Coconino National Forest for consideration. The proposals are from the Arizona Game and Fish Department to examine songbirds, Abert squirrel, and mule deer. The proposals are supported by the Forest Service and are included as part of the project proposal. The Forest Service and the Arizona Game and Fish Department are actively searching

for funding to support these wildlife monitoring efforts. Proposals are located in Appendix B.

At the time the Draft EIS was prepared, an additional proposal from the Ecological Restoration Institute (ERI) at NAU was discussed. The proposal was to examine songbirds, using a community collaborative approach. Members of NAU, the Grand Canyon Trust, Arizona Game and Fish Department, USFS, and Northern Arizona Audubon Society are working to develop a proposal that would support and enhance the monitoring efforts suggested by the Arizona Game and Fish Department. Although no formal proposal has yet been submitted, the Forest Service encourages and is actively searching for funding to support this effort.

Microhabitat Monitoring for Mexican Spotted Owls

Microhabitat monitoring will be conducted according to standard protocol as identified by Forest Service Region 3 direction.

Implementation of NEPA Decisions

Implementation will occur over many years. Prior to each year's implementation or at approximately every 3 to 5-year interval, the documentation will be reviewed to see if any new information or changed circumstances exist relating to the environmental impacts of the project. If no new findings are made, the project will continue. New findings may lead to correction, supplementation, or revision of environmental documents.

Findings and Disclosures

Several of the laws and executive orders listed in Chapter 1 require project-specific findings or other disclosures, which are included in this DEIS.

Alternatives Considered but Eliminated from Detailed Study

Several alternatives were considered during the planning process but have not been included in the DEIS for detailed study. These are described briefly below, along with the rationale for not considering them further.

Bird (April NOI response – April 19, 2001) – Alternative Suggested

The Forest Service and GCFP have not offered information that would preclude a purely process-based restoration alternative. We ask again that the Forest Service fairly and accurately analyze an alternative that would apply prescribed burns only with necessary pre-fire fuels treatments, such as raking needless from trees 24-inch dbh, pruning lower ladder branches, etc.

Response

Prescribed fire without thinning over the entire project area, as a distinct alternative, was not practical from a biological standpoint, nor did it meet the Kachina Village Forest Health Project objectives. There are seven additional types of need identified in Chapter 1, "Project Area Existing Conditions, Desired Conditions and Needs." Therefore, it was not considered as an alternative across the entire landscape. However, this treatment is incorporated into the Proposed Action to achieve a mosaic of various stand conditions and resulting effects. Prescribed fire without any mechanical thinning is proposed for those stands in which it will be effective and the desired effects are likely to be achieved.

The **prescribed fire without thinning alternative** was not developed as a distinct alternative for the entire project area because it did not meet enough of the project objectives. There are two main reasons: 1) prescribed fire alone is not effective in thinning the sizes of tree in the project area and 2) prescribed fire alone does not substantially reduce the risk of future catastrophic wildfire because not enough trees are killed. The following information discusses these two points.

1) Most studies indicate that prescribed fire alone is not effective in thinning the sizes of trees in the Kachina Village Forest Health Project.

   Prescribed fire is not a very selective thinning tool because a number of fires are required to reduce fuels, change the understory, and overcome the effects caused by fire exclusion (Harrington and Sackett 1990). Gaines et al. (1958), Woolridge and Weaver (1965), and Lindemuth (1960) all reported that fire was a rather imperfect tool for thinning. Harrington (1987) reported significant reductions in tree density within sites

occupied by "dog-hair" thickets, while the same prescribed fire did little to reduce tree density where sites were dominated by larger trees. Sackett (1980), Davis et al. (1968), and Campbell et al. (1977) reported similar results in both prescribed and natural fires (Weatherspoon 1996). In another study, Gaines et al. (1958) reported that even though younger, suppressed classes had been thinned by fire, the commercial overstory suffered substantial injury. The trees Gaines refers to as "the commercial overstory" are the larger, older trees this project wishes to retain for wildlife diversity. Lindenmuth (1960) studied the effects of fire in east-central Arizona and concluded that 24 percent of the potential crop trees were released from competition, however, 17 percent were killed or severely damaged. Again, the trees Lindenmuth refers to as "crop trees" are the larger, older trees this project wishes to retain for wildlife diversity. Harrington (1981) reported an average of 26 percent reduction in stems per acre in southeastern Arizona; however, surveys in years following the burns revealed results that need special attention, which is the subsequent loss of old-growth ponderosa pine trees.

Attempts to use fire alone to thin dense stands frequently resulted in high levels of mortality in the residual stands (Swezy and Agee 1991, Sackett et al. 1996, and Covington and Sackett 1984). Post-fire mortality among old-growth trees was 23 percent higher in burned plots than in the unburned controls over a 20-year period (Sackett et al. 1996). More than 30 years of study (since 1976) at the Fort Valley Experimental Forest has demonstrated that fire alone cannot effectively reduce stand levels enough to protect remaining mature and old-growth trees. Allowing prescribed fires or wildfires to selectively thin the pine forests of the Southwest may be the most detrimental method of retaining old-growth trees (Weatherspoon 1996).

Substantial research has demonstrated the effectiveness of thinning as one component in a forest restoration program (Swezy and Agee 1991, Fiedler 1996, Fenny et al. 1996, Weatherspoon 1996, Edminster and Olsen 1996, Covington et al. 1997, Scott 1998, and Harrington and Sackett 1990). Therefore, some combination of thinning, manual fuel removal, and prescribed burning will be necessary to restore ponderosa pine ecosystems to more natural conditions (Arno 1996; Fiedler 1996, Swezy and Agee 1991, and Oliver et al. 1994).

Most research emphasizes the imperfection of fire as a thinning tool. Prescribed fire by itself is not effective in thinning ponderosa pine trees greater than 3 inches dbh or trees that are over 6 feet tall without significant damage to the larger, older trees. The Kachina Village Forest Health Project wishes to retain the larger, older ponderosa pine trees. The trees in over-abundance and in need of thinning are predominantly 5 to 16-inches dbh (PRD's 79 and 79A).

Beginning in the 1930's, research was conducted to evaluate the effectiveness of a range of treatment strategies to reduce stand densities and fuel loads. Many researchers initially believed that simply reintroducing fire would be sufficient to substantially reduce both stand densities and fuel loads. Prescribed fire has been a successful means of fuel reduction in some forest types (Biswell et al. 1973, Knorr 1963, and Weaver 1952).

Folliott et al. (1977) reported a positive thinning response following prescribed fire in northern Arizona. However, basal area was not reduced enough for optimal stand stimulation. Weaver (1947) reported that, 30 years after burning, a young ponderosa pine stand had fewer stems per acre, greater heights, and larger diameters than an adjacent unburned stand.

2) Using prescribed fire without thinning does not substantially reduce the risk of a catastrophic wildfire.

One of the primary goals of this project is to reduce the risk of catastrophic (crown) fire. Risk reduction is accomplished by reducing the amount of ladder fuels and tree canopy fuels, as well as by reducing the amount of ground fuels (Ottmar 1997, Agee et al. 1999, Buckley 1992, and Van Wagtendonk 1996). Reducing ground fuels temporarily reduces the fuel load and ground fire intensity that could initiate a crown fire. Removing ladder fuels will reduce the potential for ground fire to

climb into the tree crowns. However, only by recreating a discontinuous canopy layer can a treatment inhibit the rate of spread and the eventual extent of a destructive crown fire.

In a report by the National Commission on Wildfire Disasters, Sampson (1994) states many forest situations will require mechanical removal of excess trees via thinning before fire can safely be re-introduced. In an extensive 1995 report to Congress, the authors of the Sierra Nevada Ecosystem Project (ponderosa pine is a major forest type in the Sierra Nevada) concluded that an extensive modification of forest structure by thinning and burning is needed to minimize severe fires in the future (McKelvey et al. 1995). In an extensive scientific evaluation (involving over 100 scientists) of the effects of Forest Service management practices on the sustainability of eastern Oregon and Washington ecosystems (ponderosa pine is a major forest type), Everett et al. (1994) found a need to use thinning as one of several actions to restore wildfire to a more natural behavior. In contrast to the destructive crown fire, a more natural fire behavior for ponderosa pine forests is a low-intensity ground fire, with flame lengths of less than 2 feet.

Bird (July 23, 2001) – Alternative Suggested

Develop a non-commercial alternative, restoration alternative that uses non-commercial treatments in the WUI*. Focus efforts on private homeowner education and assistance, encouraging re-introduction of fire outside the WUI. Homeowner education would be a coordinated program of public presentations, direct mail education, media public interest education, and news features. The local economy stimulated through local landscape businesses and construction companies retrofitting home sites for protection. Jobs and income generated by activities on Federal lands that prepare the forests outside the WUI for re-introduction of fire.

Goals include:

1. improve protection of homes;
2. economic opportunities;
3. clean water and healthy watersheds;
4. restore wildfire to forest ecology;
5. improve scientific understanding of fire ecology; and
6. improve public understanding of fire ecology and forest management.

Alt. Based on work of Jack Cohen: 40 meters of home most important; beyond 40 meters has little effect on the likelihood a home will burn.

* Inside WUI—focus on most flammable material—brush and weeds and lower branches of trees. Prioritize treatments around communities. Outside the WUI use prescribed fire—prioritize use—in conjunction with non-commercial preparation such as brush removal, needle raking and lower branch pruning. If small tree removal is scientifically justified, offer as public fuelwood by permit only.

Response

The respondent has overlooked that this project has a purpose and need which goes beyond the purpose and need for reducing fire potential. The purpose and need is aimed at long-term improvement of forest health. Seven additional topics are intertwined with fire hazard/risk reduction as identified in the Purpose and Need (see Chapter 1). The description of work proposed by the respondent within the WUI and outside the WUI are very similar. As described in the previous response, these actions would not meet the objectives of the Kachina Village Forest Health Project. Prescribed fire with only raking or pruning will not meet most of the purpose and need for this project.

The Federal Government does not have the authority to require homeowners to change physical conditions present on private land. However, the city and county have some authority through ordinances and such. In the Flagstaff community, the Forest Service and local fire departments have provided education, as well as assistance, to private landowners to reduce wildfire risk. The Proposed Action includes ongoing efforts such as working with homeowners adjacent to the communities of Flagstaff, Kachina Village, Mountainaire, and Forest Highlands. Local fire departments, as well as the Forest Service, have conducted public presentations and completed direct mail education. Almost daily, there are articles in the paper and news media across the West regarding homeowner preparedness. However, these actions in and of themselves will not solve the problems south of Kachina Village and Forest Highlands.

There are numerous small businesses in the Flagstaff area that conduct thinning and prescribed burning on private land and are replacing shake-shingle roofs with metal roofs. Many of the goals of your alternative are similar to our goals and the

goals of the Grand Canyon Forests Partnership. However, your goals will never be met with the alternative you have recommended, especially Item 1, "Improve protection of homes."

All lands adjacent to Forest Highlands and Kachina Village that are in need of treatment to address declining forest health and reduce high fire hazard are proposed for treatment. A fire in this area, as shown with Farsite Fuels Modeling (PRD 73), will easily travel 2.5 to 3 miles in one afternoon, thereby prompting us to look at the entire area to protect MSO PAC's, old-growth habitats, old trees, northern goshawk habitat, cultural sites, the Oak Creek Watershed, and homes in Forest Highlands and Kachina Village. Direction in the Forest Plan provides guidance on the size and scale of the urban interface. Page 93 of the Forest Plan defines the urban interface as an area up to 10 miles long in a southwesterly direction from urban areas.

Reducing stand densities throughout the Kachina Village Project area is critical to reducing fire potential. The single most ecologically damaging and life threatening forest fire is the crown fire. The intensity of crown fires prevents direct fire suppression. The massive blizzard of embers associated with crown fires leads to long-range spot fires, which travel over and beyond areas with little fuel. The presence of numerous spot fires leads to erratic fire behavior and rapid acceleration in a fire's growth. The most critical element in fire management is the prevention of crown fires. It is important to evaluate fire potential miles away from communities as well as immediately adjacent to them.

Nowicki – Suggested Alternative

In fact, even a 12-inch dbh cutting limit would not impede the treatments from achieving the stated objectives, as a large proportion of the trees in the project are smaller than 12-inches dbh. That is, thinning treatments would be able to create a diversity of stand densities and structures by implementing varying levels of thinning the trees less than 12-inches dbh. This analysis and cutting limit is absolutely necessary to protecting vital components of the current forest structure, and the next generation of old-growth that will develop in the forest.

Response

A 12-inch limit was analyzed using the Forest Vegetation Simulator (FVS) computer model and applying professional knowledge to decide if would result in a viable alternative for the Kachina Village Forest Health Project. The analysis looked at the viability of a 12-inch limit over the entire area, as suggested by the comment provided.

FVS was used to model various thinning scenarios. These scenarios showed the resulting differences in diameter, density, and mortality conditions after thinning. These scenarios analyzed certain alternatives, such as what happens if we impose a 12-inch limit on cutting trees. Seven stands were selected to model that show a range of both densities and site indexes that reflect the Kachina project area in general. In all the scenarios, only ponderosa pine was simulated for cut, even though many of the stands have an oak component.

A 12-inch limit scenario attempted to cut stands to a 50 basal area (BA) and an 80 BA, which is needed to meet goals and objectives in the Proposed Action such as reducing wildfire potential, increasing understory, and increasing individual tree growth. In most cases, 50 BA could not be achieved, even when the model cut almost everything (a cutting efficiency of 0.95) between 5 to 12-inches dbh. Four out of the seven stands that were modeled still had considerable BA over 50. The 12-inch limit scenario also tends to have slightly lower future growth rates for the remaining trees than other alternatives modeled. Growth was evaluated over a 50-year period. The model also indicated a higher mortality rate in stands treated with a 12-inch limit over the same 50-year period. Overall, the target densities recommended in the Proposed Action (Alternative A) could not be met with the 12-inch limit. Objectives to enhance understory, create grassy openings, and reduce wildfire potential could not be met in the majority of the project area if a 12-inch diameter limit were imposed. To enhance understory, it is desirable to reduce BA to less than 40. Diameter limits in general reduce our ability to create grassy openings, due to the distribution of trees on the landscape. A 12-inch diameter limit would make it impossible to meet our objective for creating 10 percent grassy openings within treated stands. Higher BA's resulting from a 12-inch cutting limit would not adequately decrease stand densities and achieve our goal of reducing fire potential. Fire potential would remain moderate to high across most of the project area.

Alternatives Considered in Detail

The Proposed Action (Alternative A) and four additional alternatives are considered in detail. Alternative B is the no-action alternative, under

which the project area would have no project activities at this time and would remain subject to natural or ongoing changes only. The other action alternatives represent different means of satisfying the purpose and needs, to varying degrees, by responding with different emphases to the significant issues discussed in Chapter 1. **The alternatives for the Kachina Village Forest Health Project are differentiated primarily by a limit on the size of tree to be thinned, the intensity of the treatments proposed in thinning units, and miles of temporary road.** Maps of all alternatives considered in detail are provided in Appendix C ("Alternatives A, C, D Thinning" and "Alternative E Thinning"). Figures 12 and 13 (displayed on following pages) provide an overview of the various treatments and intensities.

Visual simulations produced by *Visual Nature Studio* Software are included to compare and contrast the alternatives. The visual simulations are a photo realistic power tool from 3D Nature, makers of the award-winning World Construction Set. They portray actual places using stand data and present complex spatial concepts to display forest management proposals. The visual simulations are discussed in detail in Appendix D. Figures 6 through 11 (on the following pages) provide visual simulations of varying basal area conditions so that the reader might have a better understanding or image of the treatments as they are described in alternative discussions that follow. Visual simulations will also compare the visual effects of treatments located north of Kelly Canyon (Figures 14 through 19) and compare the visual effects of treatments in Mexican Pocket (Figures 20 through 22). These are located in "Comparison of Alternatives" later in this chapter. Larger scale maps of the alternatives are contained in the project planning record.

Alternative A - Proposed Action cutting some trees over 16-inches dbh under specific criteria only.

Alternative B - No Action.

Alternative C - Proposed Action cutting no trees over 16-inches dbh.

Alternative D - Proposed Action cutting some trees over 16-inches dbh under specific criteria only and cutting no trees over 18-inches dbh.

Alternative E - Proposed Action with modifications based on issues of roads and concerns for wildlife habitat posed by the Southwest Forest Alliance.

(Alternatives A, C, D, and E have many similar actions that were previously described in "Items Common to All Action Alternatives," "Project Specific Mitigation," and "Monitoring.")

Differences in basal areas are displayed in Figures 6 through 11 to compare and contrast the various alternatives.

Proposed Action (Alternative A)

Administrative and Strategic Direction for the Project Area

Retain all existing mature ponderosa pine trees or old "yellow-barked" trees. Thinning objectives will be met by primarily thinning smaller diameter ponderosa pine trees. Alternative A does not include a diameter limit. We recognize and acknowledge the important role that 16 inch and larger trees play in the ecosystem. Snag recruitment, future old-growth objectives, and managing for the Northern goshawk are important considerations to take into account before cutting a 16-inch dbh pine. However, some black-barked trees larger than 16-inches dbh may be removed to achieve important and valuable objectives, such as creating grassy openings, and reducing wildfire potential. This alternative includes a strict set of guidelines regulating the size of trees that would be thinned. Ponderosa pine trees larger than 16 inches may be removed only to:

- create grassy openings;
- enhance existing forest openings;
- enhance growth and health of larger ponderosa pine to promote future old-growth; and,
- reduce fire potential.

Temporary road or landing locations needed to achieve removal objectives will avoid large diameter trees where possible. Temporary road construction will be required to conduct thinning within the project area. We have estimated 5.75 miles of temporary roads will be required to implement the Proposed Action. These temporary roads will be obliterated following thinning treatments. Level 2 and 3 roads will be used for thinning activities as well. Some roads will need to be improved before the initiation of thinning activities.

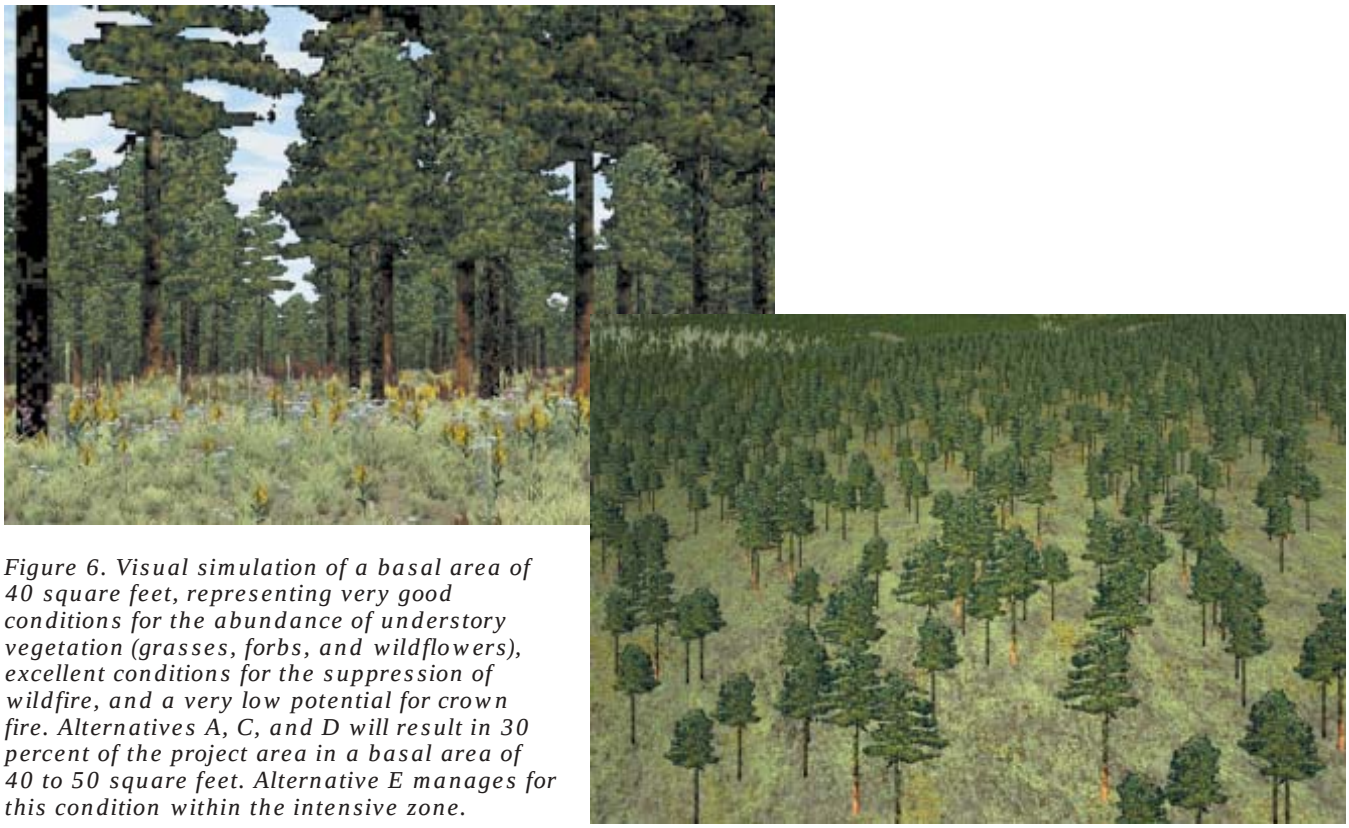

Figure 6. Visual simulation of a basal area of 40 square feet, representing very good conditions for the abundance of understory vegetation (grasses, forbs, and wildflowers), excellent conditions for the suppression of wildfire, and a very low potential for crown fire. Alternatives A, C, and D will result in 30 percent of the project area in a basal area of 40 to 50 square feet. Alternative E manages for this condition within the intensive zone.

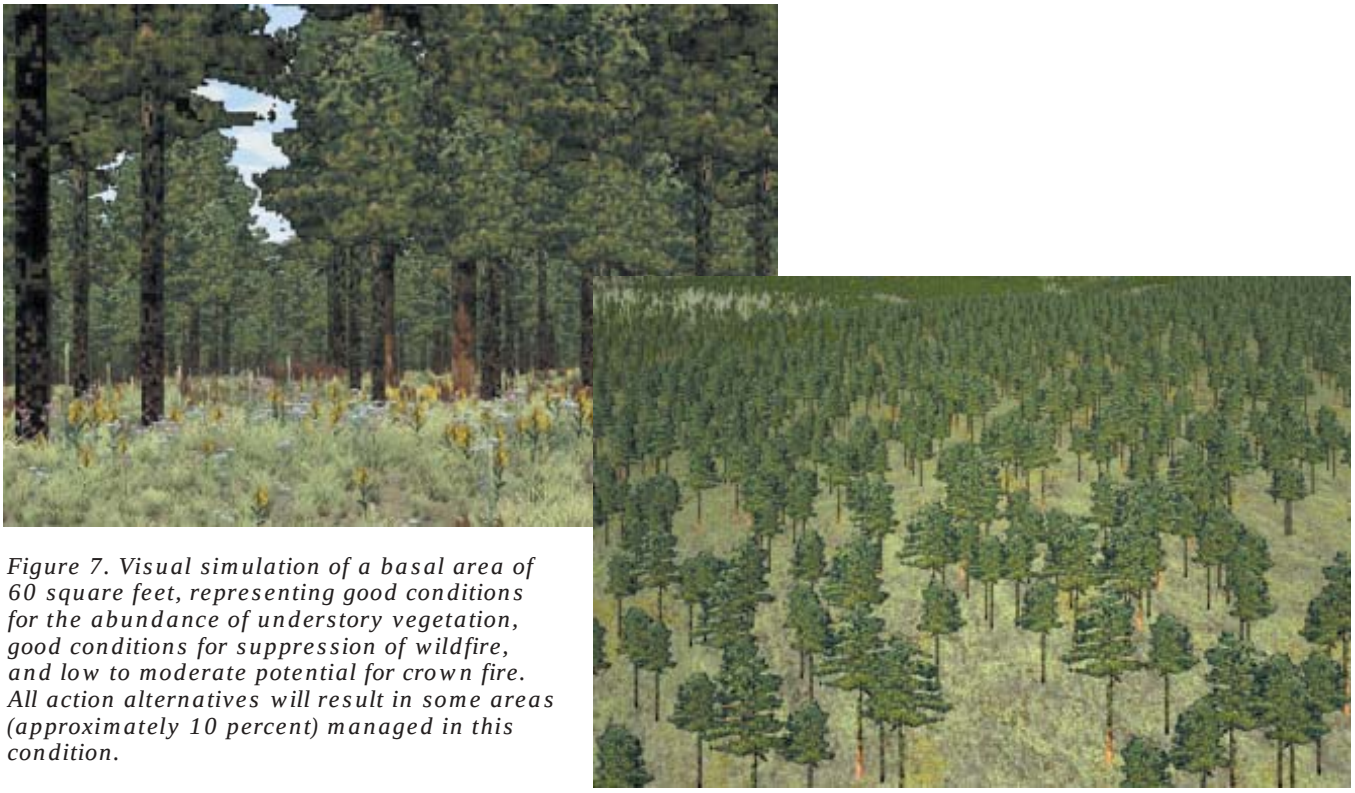

Figure 7. Visual simulation of a basal area of 60 square feet, representing good conditions for the abundance of understory vegetation, good conditions for suppression of wildfire, and low to moderate potential for crown fire. All action alternatives will result in some areas (approximately 10 percent) managed in this condition.

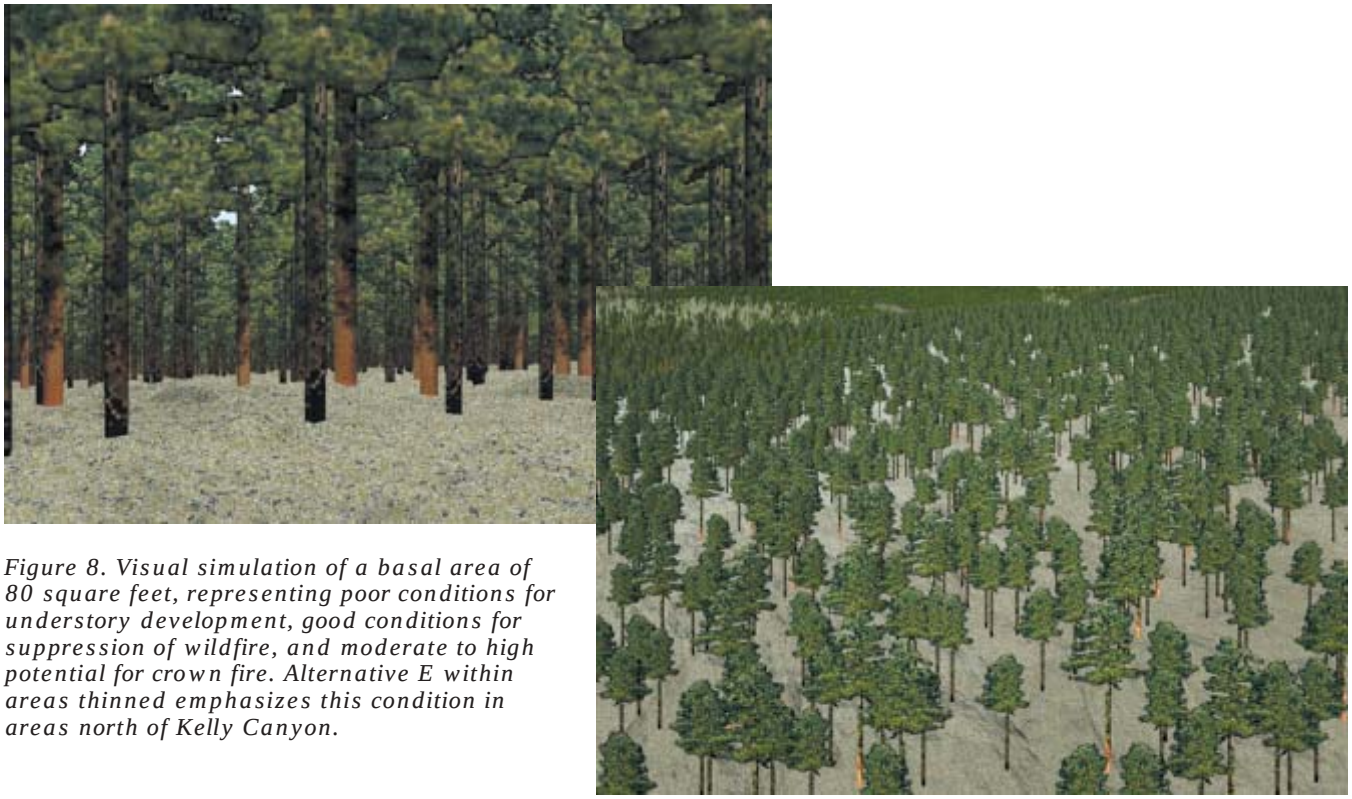

Figure 8. Visual simulation of a basal area of 80 square feet, representing poor conditions for understory development, good conditions for suppression of wildfire, and moderate to high potential for crown fire. Alternative E within areas thinned emphasizes this condition in areas north of Kelly Canyon.

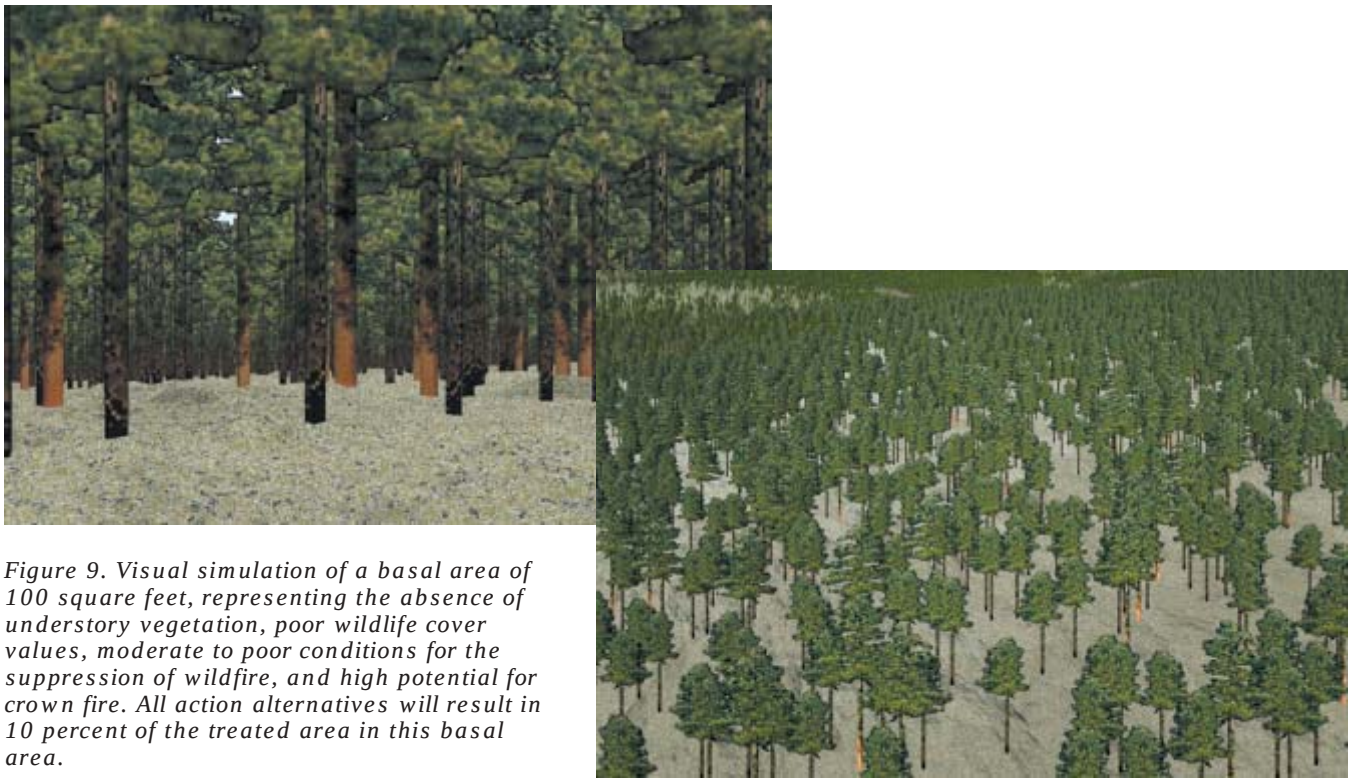

Figure 9. Visual simulation of a basal area of 100 square feet, representing the absence of understory vegetation, poor wildlife cover values, moderate to poor conditions for the suppression of wildfire, and high potential for crown fire. All action alternatives will result in 10 percent of the treated area in this basal area.

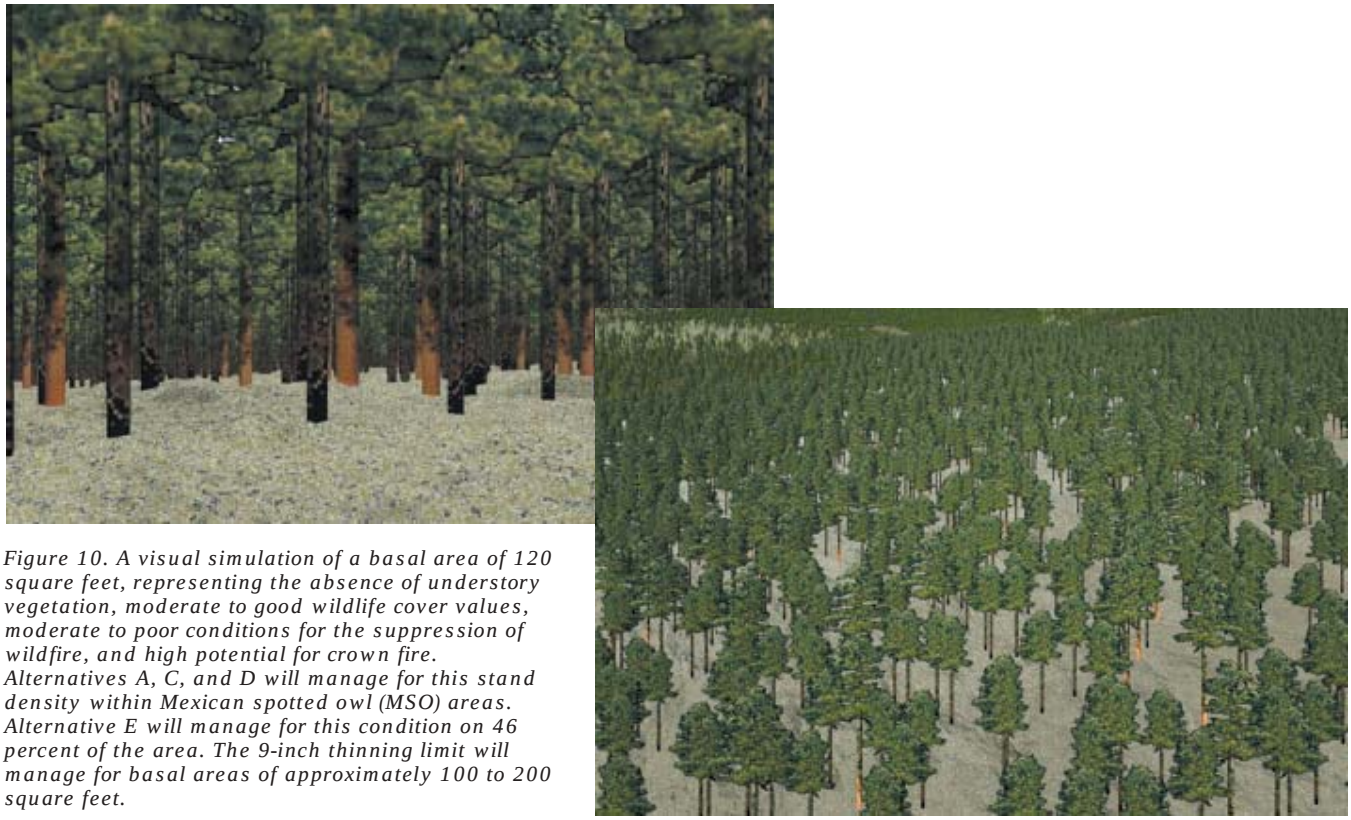

Figure 10. A visual simulation of a basal area of 120 square feet, representing the absence of understory vegetation, moderate to good wildlife cover values, moderate to poor conditions for the suppression of wildfire, and high potential for crown fire. Alternatives A, C, and D will manage for this stand density within Mexican spotted owl (MSO) areas. Alternative E will manage for this condition on 46 percent of the area. The 9-inch thinning limit will manage for basal areas of approximately 100 to 200 square feet.

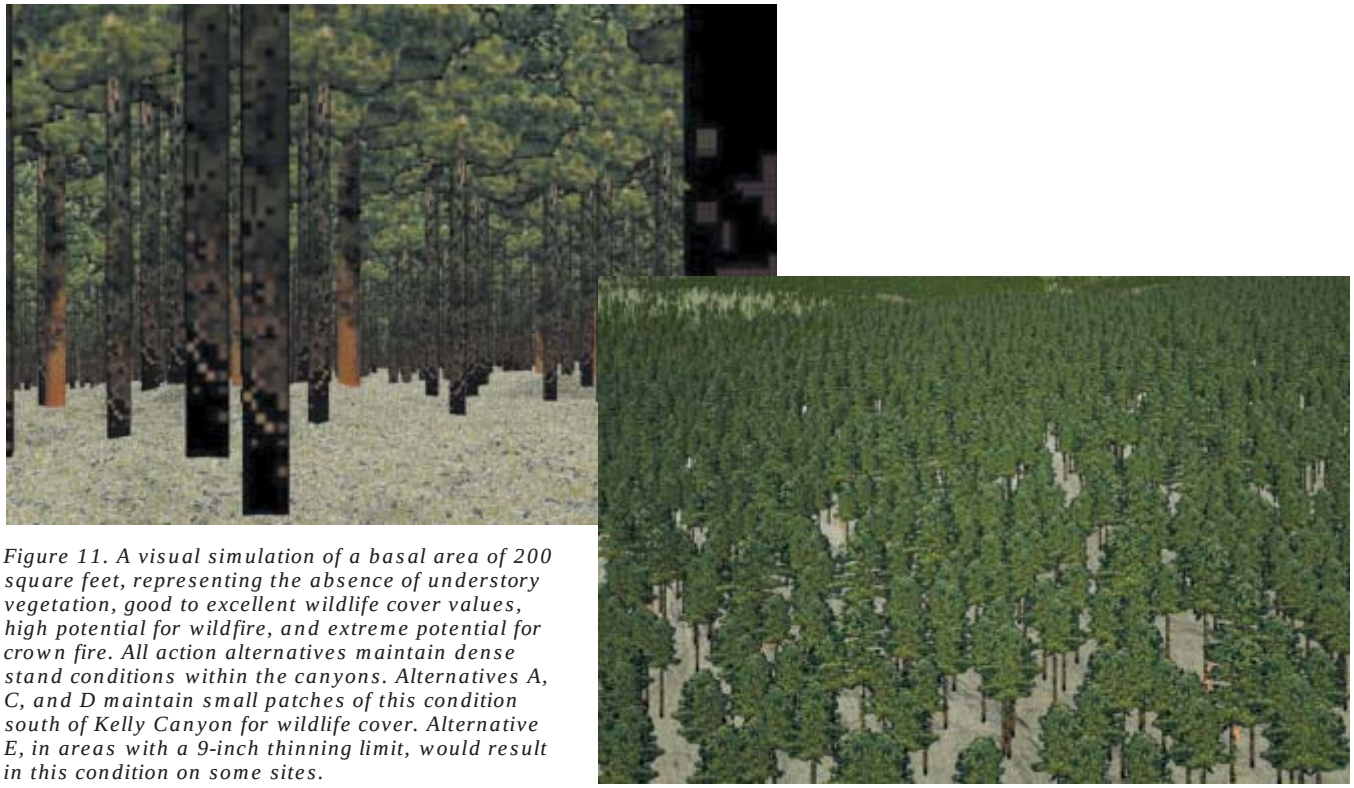

Figure 11. A visual simulation of a basal area of 200 square feet, representing the absence of understory vegetation, good to excellent wildlife cover values, high potential for wildfire, and extreme potential for crown fire. All action alternatives maintain dense stand conditions within the canyons. Alternatives A, C, and D maintain small patches of this condition south of Kelly Canyon for wildlife cover. Alternative E, in areas with a 9-inch thinning limit, would result in this condition on some sites.

Snags and logs will be created from some of the 16-inch dbh black-barked trees as we work toward meeting guidelines for these habitats. Emphasis for snag and log recruitment will be in the areas south of Kelly Canyon, in northern goshawk PFA's, and in developing old-growth. Data has been collected on existing log, snag, and yellow-barked trees and will be used to select recruitment areas and describe recruitment densities. Selection of logs and snags will be made during marking for the project as described in PRD 120.

Actions to Meet Objectives for Reducing Fire Potential – Improving Forest Ecosystem Health – Fuels and Vegetation Management

1. Fire potential reduction and forest health improvement – North of Kelly Canyon and Lower Highway 89A Corridor (Variable thinning 40 to 120 BA with creation of openings 10 percent)

Thinning from below is proposed on 1,924 acres in areas north of Kelly Canyon and along the Highway 89A corridor. Thinning will focus on reducing wildfire potential by reducing ladder fuels and breaking up continuous crown canopies. The thinning of small trees will develop clumps of trees in a mosaic of varying densities, ranging from 40 to 120 square feet of basal area[4]. The clumps will be selected based on existing structure. Canopy closure will be reduced to 40 to 50 percent, with crown base height raised to an average of 15 feet. All old trees will be deferred from treatment and remain on the site. Thinning will occur around old trees to reduce competition for light, moisture, and nutrients to improve their longevity. Approximately 10 percent of the area will be managed to provide for grassy openings. Grassy openings will be managed by using the existing areas on the landscape where open areas may have occurred in the past or have been created. Trees around the edges of the openings or within the interior of the opening will be removed to expand the size of the opening. The openings will be irregular in shape to create stringers of openings that will improve the understory and reduce fire potential. Thinning will also occur around large Gambel oak trees and clumps to improve their longevity. No Gambel oaks will be cut. This thinning will be very similar to the thinning proposed around the old trees. Thinning will enhance vigor and growth of oak in the area and reduce fire potential. Removing the pine canopy surrounding Gambel oak will reduce the potential for fire ladders.

2. Dense Canopy Retention for Improving Forest Resiliency of Goshawk Habitat (Variable thinning to average of 80 BA with openings created)

Within northern goshawk post fledging areas (PFA's), 124 acres will be thinned to lessen fire potential by removing ladder fuels and creating some canopy breaks. Scientists who developed management recommendations for this species recommend this type of treatment to reduce fire potential and improve northern goshawk habitat. A more dense stand or stands with higher canopy closure will exist after treatment than is prescribed for much of the area surrounding this PFA (as described above). Canopy cover will average 60 percent within the 124 acres of treatment.

3. Improving Old Tree Longevity and Gambel Oak Habitat (Variable thinning around old trees and Gambel oak)

Four hundred eighteen acres of thinning from below will be conducted within and around mature ponderosa pine trees and Gambel oak. In these stands, there are opportunities to conduct limited thinning around the old trees and Gambel oak to improve their longevity. Openings created around Gambel oak and mature ponderosa pine will reduce fire potential, decrease competition for sunlight, moisture, and nutrients, and create grassy openings. Where opportunities arise to improve the distribution and abundance of openings in these stands, additional thinning may occur.

4. Fire potential reduction, forest health improvement, and wildlife cover management – South of Kelly Canyon (Variable thinning 40 to 100 BA with 25 percent cover patches maintained with the creation of openings 10 percent)

South of Kelly Canyon, between James and Kelly Canyons, and South of James Canyon, 1,411 acres of thinning from below will occur to lessen the fire potential. Along the rims of the canyons, a fire line approximately 3-feet wide will be constructed either by using a drag, small bobcat, or hand crews. The fire line will be constructed approximately 200 to

[4] Basal area is a measure used to describe tree density. Basal area can be visualized as the amount of ground that is covered in wood. Higher basal areas mean more trees are left (higher densities) than lower basal areas (lower densities).

300 feet above the steep break of the canyon below. The 200 to 300-foot area between the edge of the canyon and the fire line will assist in prescribed burning activities and will maintain key habitat for bear and turkey using the edges of the canyons for wildlife movement. Beyond this fire line, the ridge between James and Kelly Canyons and south of James Canyon will be thinned to create an open ponderosa pine habitat with dense cover patches. Up to 25 percent of the area will be in dense patches of variable size, with a minimum of 35 trees per dense clumps (small clumps). The size of these clumps will vary from approximately 1/10th of an acre to 1 acre. Some light thinning may occur within the patches to reduce ladder fuels or remove trees with poor crown development. The clumps will be closed canopy clumps, with the limbs and needles of the trees interlocking. These clumps are important to a variety of bird species and to Abert squirrel and deer for bedding. The dense clumps will be selected using the existing vegetation or existing structure and consideration of fire hazard. Around these dense clumps, the area will be open ponderosa pine habitat. The thinning around the clumps will maintain tree densities between 40 to 100 square feet of basal area. The savannah or open area around the clumps will reduce fire potential, increase the herbaceous understory, and benefit wildlife species, such as blue birds, rabbits, turkey, and deer, requiring open habitats for foraging.

As described above for areas north of Kelly Canyon, the following will also occur south of Kelly Canyon. All old trees will be deferred from treatment and retained. Thinning will occur around old trees to improve their longevity by reducing competition for light, moisture, and nutrients. Approximately 10 percent of the area will be managed to provide for grassy openings by using the existing areas on the landscape where grassy openings may have occurred in the past or have been created. Trees around the edges of the openings or within the interior of the opening will be removed to expand the size of the opening. The openings will be irregular in shape and will create stringers of openings to improve understory development and reduce fire potential. Thinning will also occur around large Gambel oak trees and clumps to improve their longevity. This thinning will be similar to the thinning proposed around the old trees. No Gambel oaks will be cut. This will enhance vigor and growth of oak in the area and reduce fire potential. Removing the pine canopy surrounding Gambel oak will reduce fire laddering potential.

Site-specific implementation will include layout and assistance with marking and thinning from the Arizona Game and Fish Department and USFS wildlife biologists.

Within the Mexican Pocket area, thinning similar to that proposed for areas south of Kelly Canyon will be conducted. However, the dense cover patches, as described above, will be focused on north-facing slopes. The dense patches will be less evenly distributed. Two hundred forty-six acres

have a high density of old yellow pine clumps, providing for more dense patches throughout much of the area. These old yellow pine groups will be maintained. Thinning around the groups will help improve their longevity, lessen fire potential to the groups, and improve aesthetic values in the area.

Site-specific implementation will include layout and assistance with marking and thinning from the Arizona Game and Fish Department and USFS wildlife biologists.

5. Thinning from Below – Griffiths Spring Drainage

Eighty-two acres of thinning involving trees less than 9-inches dbh will occur along the Griffiths Spring drainage. Light thinning is proposed to reduce fire potential and balance visual quality concerns in a heavily-used area.

No Action (Alternative B)

Description of Alternative B

The No Action Alternative would propose no future management activities within the project area at this time. It does not preclude activities in other areas at this time or from the project area at some time in the future. The Council on Environmental Quality (CEQ) regulations (40 CFR 1502.14d) require that a “no action” alternative be analyzed. This alternative represents the existing condition against which the other alternatives are compared.

Summary of Significant Issues That Developed Alternative B

No significant issues raised during scoping or comment to the Proposed Action are addressed by the No Action Alternative. However, many comments and non-significant issues are addressed through the No Action Alternative (see Appendix A).

Purpose and Need Evaluation

The No Action Alternative does not meet the purpose and need for the proposed project.

Specific Outputs and Differences Between the Proposed Action (Alternative A) and Alternative B

The No Action Alternative would maintain current conditions within the project area. Wildfire potential would remain high. There would be no improvement in forest health. Recreation and road management would continue to contribute to the current high fire risk and would continue to impact wildlife habitat, soil, and watershed conditions.

Alternative C

Description of Alternative C

This alternative is identical to the Proposed Action (Alternative A) except that this alternative will not cut any trees over 16-inch dbh.

Administrative and Strategic Direction for the Project Area

Retain all existing mature ponderosa pine trees or old "yellow-barked" trees. Thinning objectives will be met by primarily thinning smaller diameter ponderosa pine trees. Ponderosa pine trees greater than 16-inch dbh will be retained. This alternative would drop the creation of logs and snags.

Summary of Significant Issues That Developed Alternative *C*

Issue 1: 16-Inch Diameter Limit Issues

Cutting trees greater than 16-inch diameter would affect future old-growth in the area, resulting in fewer acres being able to qualify as old-growth forest structure in the future.

Purpose and Need Evaluation: The alternative generally meets the desired future conditions described under the purpose and need of the project. There are only slight differences when comparing Alternative C to the Proposed Action (Alternative A). The implementation of a 16-inch diameter limit would result in approximately 7,000 fewer trees thinned from the landscape compared to the Proposed Action. Based on professional experience and modeling, this is estimated to result in 50 percent fewer grassy openings created, thus leading to less improved habitat for Navajo Mountain Mexican voles and sensitive plant species in the project area. The alternative would result in slightly higher fire potential.

Specific Outputs and Differences Between the Proposed Action (Alternative A) and Alternative C

Related to Issues

Issue 1: Cutting trees greater than 16-inch diameter would affect future old-growth in the area, resulting in fewer acres being able to qualify as old-growth forest structure in the future.

A detailed analysis of old-growth is located in Chapter 3. The effects analysis states there is relatively no difference between the Proposed Action (Alternative A) and Alternative C (16-inch diameter limit) in regard to future old-growth recruitment.

Map of Alternative C: A detailed map of Alternative C is located in Appendix C.

Alternative D

Description of Alternative D

This alternative is identical to the Proposed Action (Alternative A) except that this alternative would not cut any tree over 18-inches dbh.

Administrative and Strategic Direction for the Project Area

Retain all existing mature ponderosa pine trees or old "yellow-barked" trees. Thinning objectives will be met by primarily thinning smaller diameter ponderosa pine trees. Ponderosa pine trees greater than 18-inches dbh will be retained.

Creating Logs and Snags - Snags and logs will be created from some of the 18-inch dbh black-barked trees as we work toward meeting guidelines for these habitats. The alternative maintains the element of creating logs and snags from the trees 16 to 17.9 inches dbh. Emphasis for snag and log recruitment will be in the areas south of Kelly Canyon, in northern goshawk PFA's, and in developing old-growth. Data has been collected on existing log, snag, and yellow-barked trees and will be used to select

recruitment areas and describe recruitment densities. Selection of logs and snags will be made during marking for the project as described in PRD 120.

Summary of Significant Issues That Developed Alternative D

Issue 2: 18-Inch Diameter Limit Issue

All project objectives could be met with an 18-inch diameter limit and request that a quantitative analysis is provided.

Purpose and Need Evaluation: The alternative meets the desired future conditions described under the purpose and need of the project. There are only slight differences when comparing Alternative D to the Proposed Action (Alternative A), as described in Chapter 3. Cutting no trees greater than 18-inches dbh would result in approximately 2,000 fewer trees thinned from the landscape. Grassy openings created would be the same as Alternative A. An evaluation conducted by specialists found little to no difference between the Proposed Action (Alternative A) and Alternative D upon detailed study.

Specific Outputs and Differences Between the Proposed Action (Alternative A) and Alternative D Related to Issue 2

There is little to no difference between the Proposed Action (Alternative A) and Alternative D.

Map of Alternative D: A detailed map of Alternative D is located in Appendix C.

Alternative E

Description of Alternative E

Alternative E is different from the Proposed Action (Alternative A). The thinning units are the same, however, different thinning prescriptions are applied to the units based on issues. The alternative looks at thinning prescriptions that change the intensity of thinning and a 16-inch diameter limit is in place like Alternative C. There are fewer temporary roads and less mechanized equipment used.

Administrative and Strategic Direction for the Project Area

Retain all existing mature ponderosa pine trees or old "yellow-barked" trees. Thinning objectives will be met by primarily thinning smaller diameter ponderosa pine trees. Ponderosa pine trees greater than 16-inches dbh will be retained.

Temporary roads or landing locations to achieve removal objectives will avoid large diameter trees where possible. Temporary roads would be used to thin the "Intensive Zone" described below. Approximately 2.5 miles of temporary roads would be required. These temporary roads will be obliterated following thinning treatments. Level 2 and 3 roads will be used for thinning activities as well. Some roads will need to be improved before initiation of thinning activities.

Reducing Fire Potential – Improving Forest Ecosystem Health – Fuels and Vegetation Management

"Intensive Zone" Thinning – Adjacent to Private Land (Variable thinning 40 to 50 BA). Implement thinning from below to create a fuel break north of Kelly Canyon within the "intensive zone," i.e., 1/8 mile (660 feet) immediately adjacent to homes. The "intensive zone" should leave very few interlocking crowns and provide a fuel break adjacent to private land. Temporary roads could be established to thin the "intensive zone" (Nowicki - PRD 119). The "intensive zone" is 439 acres.

Fire potential reduction and forest health improvement – North of Kelly Canyon and Lower Highway 89A Corridor (Variable thinning 60 to 120 BA). Beyond the 1/8-mile "intensive zone," implement a variable "thinning from below" to 60 to 120 BA north of Kelly Canyon on 1,746 acres.

Fire potential reduction and reducing temporary road construction—North of Kelly Canyon and Lower Highway 89A Corridor (to reduce temporary road construction do not thin any tree over 9-inches dbh). In the areas north of Kelly Canyon, 363 acres could not be reached using the existing road network and would require temporary road construction. The alternative discussed with Brian Nowicki on several occasions resulted in these units having a 9-inch diameter limit. South of Kelly Canyon, 363 acres would be thinned from below, with nearly all 9-inch trees thinned, stacked, and burned.

Reducing disturbance to soils and wildlife – South of Kelly Canyon, including Mexican pocket area (No use of heavy equipment, all treatments completed with hand thinning methods only, do not thin any trees over 9-inches dbh). South of Kelly Canyon 2,020 acres would be thinned from below, with nearly all 9-inch and smaller trees thinned, stacked, and burned.

Thinning from below – Griffiths Spring Drainage. Sixty two acres of thinning involving trees less than 9-inches dbh will occur along the Griffiths Spring drainage. Light thinning is proposed to reduce fire potential and balance visual quality concerns in a heavily-used area.

Summary of Significant Issues That Developed Alternative E

Issue 3: "Intensive Zone"

The Proposed Action does not reduce fuels sufficient to protect the immediate wildland-urban interface. An "intensive treatment zone" around private land is requested for evaluation.

Issue 4: Lighter Thinning Methods

Thinning north of Kelly Canyon as described in the Proposed Action goes beyond what is needed to reduce fire risk. A lighter treatment of 60 to 120 basal area and no trees cut over 9-inches dbh to reduce the need for temporary road construction is requested for evaluation.

Issue 5: Road Issues

Temporary roads lead to increased soil compaction, transport of exotic weeds, and have long-lasting impacts on forest structure, therefore, we request that no new temporary roads be created even if only for the duration of the project.

Issue 6: Mechanized Equipment

Mechanized equipment and excessive thinning will increase soil compaction and cause disturbance to wildlife in areas south of Kelly Canyon. The area south of Kelly Canyon should only be treated with hand thinning and was requested for evaluation.

Purpose and Need Evaluation

Alternative E falls severely short of achieving the desired outcomes specified in the purpose and need. Alternative E will result in very little protection of T&E habitat and urban areas from wildfire. Thinning no trees over 9-inches dbh does very little to reduce flame lengths and results in little or no change in expected fire behavior when compared to the No Action Alternative. Nearly 2,400 acres treated under Alternative E would remain in high wildfire potential with flame lengths averaging 7.2 feet. Tree mortality following a wildfire is estimated at 80 to 100 percent. Other differences in outputs include the creation of very few openings, with Alternative E creating less than 1 percent new openings. Alternative E has long-term negative impacts on developing old-growth and stand health. Alternative E showed very little improvement to wildlife habitat.

Specific Outputs and Differences Between the Proposed Action (Alternative A) and Alternative E Related to Issues

Issue 3

The Proposed Action does not reduce fuels sufficient to protect the immediate wildland-urban interface. An "intensive treatment zone" around private land is requested for evaluation.

The "intensive treatment zone" concept is analyzed in detail in Chapter 3. The effects analysis states that on the Coconino National Forest, a 660-foot-wide fuel break has not proven to be an effective fire stop against fires approaching from beyond such a strip. An illustration is the Slate Fire (1996). An entire strike team of wildland fire engines was unable to even slow down the forward spread of the fire at any of three separate breaks similar to the "intensive zone" treatment proposed.

Issue 4

Thinning north of Kelly Canyon as described in the Proposed Action goes beyond what is needed to reduce fire risk. A lighter treatment of 60 to 120 basal area and no trees cut over 9-inches dbh to reduce the need for temporary road construction is requested for evaluation.

Alternative E would fail to meet other fire-related objectives within 1 mile of the residential neighborhoods, since flame lengths and fire intensity generated by the model were not reduced from the existing condition. The probability of large tree (12 to 20" dbh) mortality would remain very high at over 90 percent. However, the flame length that would likely be needed to transition into a crown fire would be increased to 7.9 feet by this alternative (within this northern zone). Farther than 1 mile, yet north of James Canyon, the model indicated Alternative E would reduce flame lengths from 7.2 feet to approxi-

mately 4 feet and the probability of tree mortality from 90(+) percent to 16(-) percent for a wildfire originating in this zone. Within this zone, the model indicated the only significant difference in tree mortality between the action alternatives was among trees less than 12-inches dbh. Alternative E leaves a higher degree of closed canopy (in this middle zone) that could increase tree group torching and spotting.

Issue 5

Temporary roads lead to increased soil compaction, transport of exotic weeds, and have long-lasting impacts on forest structure, therefore, we request that no new temporary roads be created even if only for the duration of the project.

Alternative E results in 2.5 miles of temporary road construction compared to the Proposed Action (Alternative A), which results in 5.75 miles of temporary road construction. This translated to a difference of 8 acres on the ground. The change to forest structure is insignificant, as only .0017 percent of the project area is affected by this action. There was no detectible change to soil compaction due to the short-term duration of use and mitigation applied to the Proposed Action (Alternative A). Alternative E would reduce the potential for invasive and noxious weed invasion on 8 acres of the landscape, an insignificant change when considering there are 177 acres or 50 miles of existing roadways. Temporary roads will result in little change to invasive and noxious weed spread.

Issue 6

Mechanized equipment and excessive thinning will increase soil compaction and cause disturbance to wildlife in areas south of Kelly Canyon. The area south of Kelly Canyon should only be treated with hand thinning and was requested for evaluation.

The effects from Alternative E on soil compaction will be slightly less due to the limited equipment use in areas south of Kelly Canyon. However, undesirable effects from the proposed activities will be mitigated through the implementation of Best Management Practices and the effects of activities proposed in Alternative A are minimal. Effect analysis completed for Management Indicator Species, Threatened, Endangered and Sensitive species concluded that disturbance effects would be minimal under the Proposed Action (Alternative A) Proposed Action with mitigation measures applied as described previously in this chapter. There was very little difference in disturbance effects associated with the action alternatives.

Map of Alternative E: A detailed map of Alternative E is located in Appendix C.

Comparison of Alternatives

This section compares outputs, objectives, and effects of the alternatives in terms of the significant issues for the Kachina Village Forest Health Project. The discussions of effects are summarized from Chapter 3, which should be consulted for a full understanding of these and other environmental consequences.

Figures 12 and 13 are provided to contrast and compare the alternative treatments and intensities. The visual aids are followed by a discussion of each significant issue, comparing the alternatives in terms of that issue. The relevant numerical data is displayed to compare outputs, objectives, and effects of the alternatives.

Lastly, Table 5 provides an overview comparison of the alternatives **relevant to the purpose and need for the project (Chapter 1, "Purpose and Need").** The table does not include Alternative B (No Action) which has no outputs or activities.

The alternatives for the Kachina Village Forest Health Project are differentiated primarily by a limit on the size of tree to be thinned, the intensity of the treatments proposed in thinning units, and miles of temporary road.

Table 1. Comparison of Action Alternatives Based on Key Differences

Key Differences	Alternatives			
	A	C	D	E
Diameter limit	None[1]	16-inch dbh[2]	18-inch dbh[3]	16-inch dbh[4]
Thinning acres that will reduce crown fire potential	4,266	4,266	4,266	2,328
Miles of temporary roads	5.75	5.75	5.75	2.5

[1] For trees being thinned over 16-inches dbh there is specific criteria.

[2] No trees over 16-inches dbh will be harvested for any reason

[3] For trees being thinned between 16 and 17.9-inches dbh, there is specific criteria

[4] No trees over 16-inches dbh will be harvested for any reason

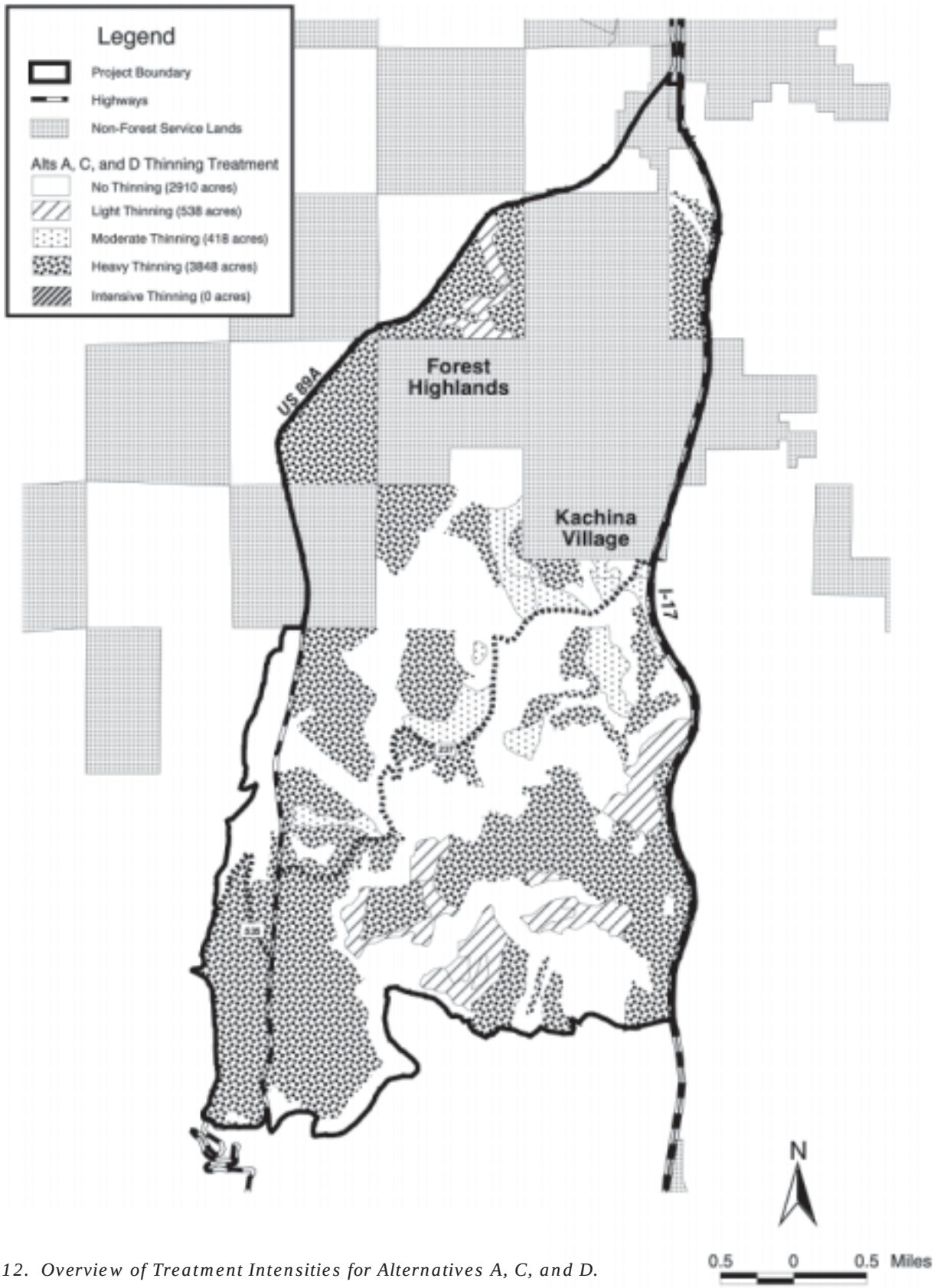

Figure 12. Overview of Treatment Intensities for Alternatives A, C, and D.

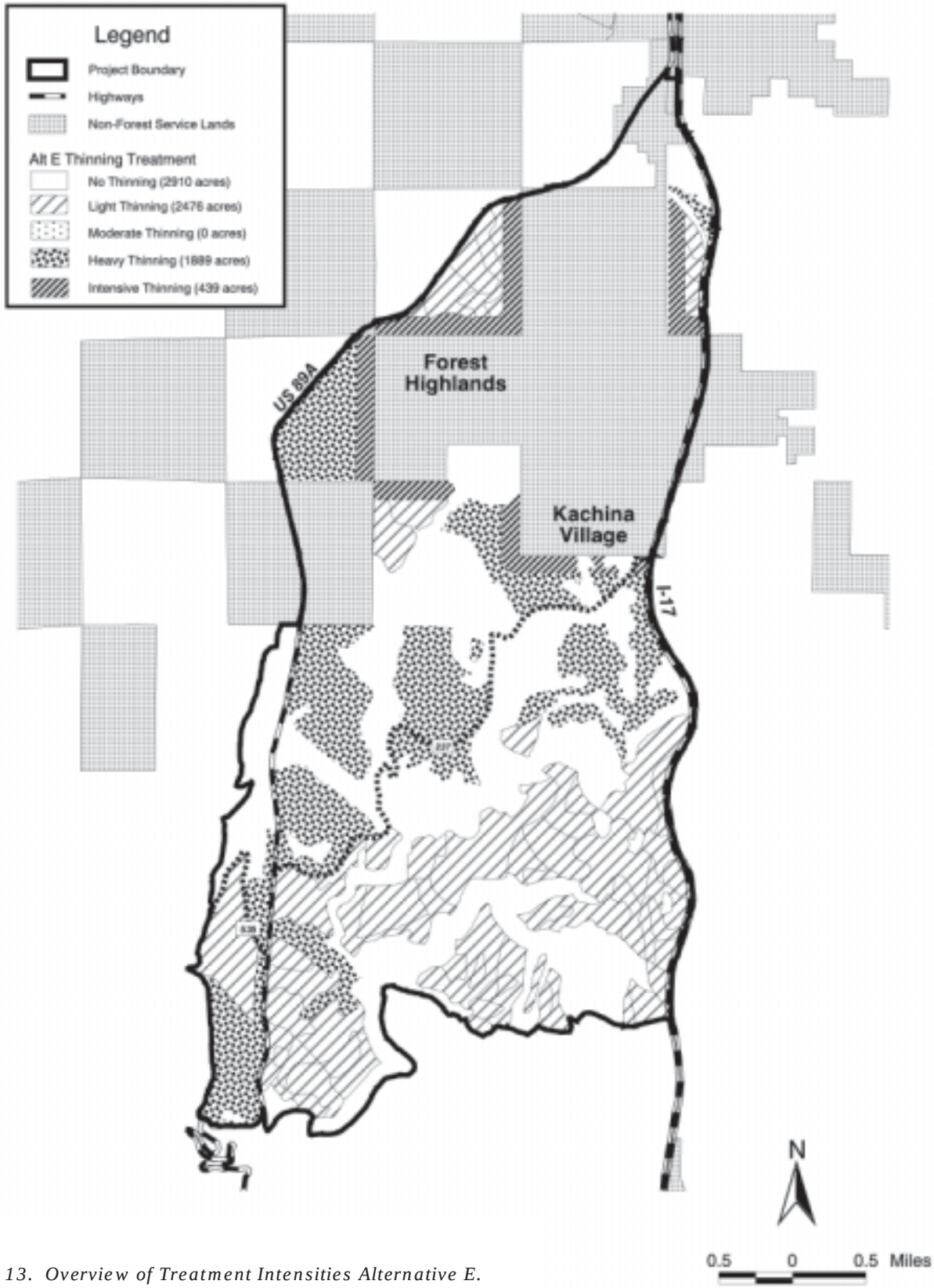

Figure 13. Overview of Treatment Intensities Alternative E.

Figure 14. Existing conditions just south of Kachina Village with Interstate 17 in the lower, left-hand corner.

Figure 15. Alternative A, following thinning as proposed for fire potential reduction and forest health improvement north of Kelly Canyon and the lower Highway 89A corridor (variable thinning 40 to 120 BA with creation of openings 10 percent). See Chapter 2.

Figure 16. Alternative E, following thinning as proposed for intensive zone adjacent to private land (variable thinning 40 to 50 BA) and fire potential reduction and forest health improvement north of Kelly Canyon and the lower Highway 89A corridor (variable thinning 60 to 120 BA). See Chapter 2.

Figure 17. Existing condition, location/site 345/01, immediately south of Kachina Village. Interstate 17 is shown in the bottom of the picture.

Figure 18. Alternative E, location/site 345/01 following thinning as proposed for intensive zone adjacent to private land (variable thinning 40 to 50 BA). See Chapter 2.

Figure 19. Alternative A, location/site 345/01 following thinning as proposed for improving old-tree longevity and Gambel oak habitat (variable thinning around old trees and Gambel oak with 10 percent openings created). See Chapter 2.

Figure 20. Existing conditions in the Mexican Pocket area, location/site 345/17. Pumphouse Canyon is visible as the dark area on the right side and Highway 89A is visible as the straight white line on the left-hand side (left photo). The picture on the left displays a high oblique; the picture on the right is a low oblique.

Figure 21. Alternative A, following thinning as proposed for fire potential reduction, forest health improvement, and wildlife cover management, south of Kelly Canyon (variable thinning 40 to 100 BA with 25 percent cover patches maintained with the creation of openings 10 percent). See Chapter 2.

Figure 22. Alternative E, following thinning as proposed for reducing disturbance to soils and wildlife, south of Kelly Canyon, including the Mexican Pocket area (9-inch thinning limit; treatments completed with hand thinning methods only. No use of heavy equipment). See Chapter 2.

Comparison of Alternatives — Issue 1: 16-inch Diameter Limit

Issue: Cutting trees greater than 16-inch diameter would affect future old-growth in the area, resulting in further degradation of old-growth forest structure.

Old-growth

Alternatives A, C, and D would thin from below both existing and developing old trees resulting in the greatest decrease in stand densities. Thinning will improve the health, growth, and vigor of the old-growth tree component and decrease the risk of wildfire, thus promoting development of old-growth habitat. All existing old-growth trees would be maintained across all action alternatives. Additionally, the different thinning prescriptions would result in varying tree densities across the landscape. This is desirable for wildlife and would help create a diversity of species across the project area. Over a period of 50 years, these alternatives would result in the greatest recruitment for old-growth into VSS 5 and VSS 6. There is relatively no difference between the Proposed Action (Alternative A), Alternative C (16-inch diameter limit), and Alternative D (18-inch diameter limit) in regards to future old-growth recruitment.

Under Alternative B (no action), the dense nature of the forest would persist. Old tree mortality would occur at a greater rate than in thinned stands due to biological stresses, such as competition, insects, disease, and wildfire. Without treatment, many old-growth recruitment areas would decline in health and vigor, with some never reaching old-growth conditions due to high tree densities. In 50 years, there would be no recruitment into VSS 5 and VSS 6. Because 95 percent of developing and existing old-growth sites have expected fire behavior rated as high to extreme, wildfire may result not only in the loss of old-growth trees but also blocks of old-growth trees.

Under Alternative E, trees would have smaller diameters due to slower growth rates. With limited treatment in sites where no trees over 9-inches dbh would be thinned, old-growth recruitment areas would decline in health and vigor, with some never reaching old-growth conditions due to high tree densities. The high fire hazard potential would persist for old-growth stands. In the event of a large wildfire, old-growth sites would be compromised and trees would be lost, thus affecting form and function of old-growth. In 50 years post-treatment, there would be little recruitment into old-growth conditions, with an increase of 18 percent in VSS 5 and no recruitment in VSS 6.

Economic Analysis

Economic analysis was conducted using techniques and methods developed by Dr. Debra Larson of Northern Arizona University. The analysis focused on the economic question of how 16 inch and greater diameter trees would contribute to total return estimates. Modeling runs were conducted using two product mixes and two logging systems reflecting local markets. Alternative B (No Action) could potentially result in a loss of over 1 billion dollars if Forest Highlands Subdivision were impacted severely by a large catastrophic fire event (Jim Pond, Highlands Fire Department personal communication). Estimates to fight such a fire were estimated at 3 million dollars. Long-term impacts to Oak Creek Canyon, wildlife habitat, and T&E habitat would be significant. Alternative A without a 16-inch diameter limit would result in a 5-10 percent positive change per thousand cubic feet (CCF) when compared to Alternative C. The estimated value of the 7,000 trees thinned using Alternative C is approximately $175,000 based on an estimated value per CCF, which is taken from Larson (2000 in press). However, given the poor tree form expected of the 16 inch diameter trees removed, the grade of these trees may not be realized in the market, which was analyzed.

Table 2. Comparison of Cost Per Thousand Cubic Feet (CCF), Number of Trees Removed Greater than 16-inches dbh, and Estimated Value for All Action Alternatives.

Economic Evaluation	Alternatives			
	A	C	D	E
Number of 16" and Greater Diameter Trees Removed	5000 (16.1-17.9) 2000 (18"+)	0	5000 (16.1-17.9)	0
Estimated Value of 16" and Greater Diameter Trees	$498,000	0	$373,500	0

Table 3. Economic Improvement

Alternative	Amount Generated or Cost
A	$510,090 generated from trees thinned.
C	$238,886 generated from trees thinned.
D	$402,045 generated from trees thinned.
E	Thinning will cost $670,975.

Comparison of Alternatives — Issue 2: 18-inch Diameter Limit

Issue: All project objectives could be met with an 18-inch diameter limit and request that a quantitative analysis is provided.

The issue is addressed in Alternative D. The specific issue was that all project objectives could be met with an 18-inch diameter limit. A review of Chapter 3 finds very few differences between the Proposed Action (Alternative A) and Alternative C and that project objectives were met equally to the Proposed Action (Alternative A).

Comparison of Alternatives — Issue 3: "Intensive Zone"

Issue: The Proposed Action does not reduce fuels sufficient to protect the immediate wildland-urban interface. An "intensive treatment zone" around private land is requested for evaluation.

Fuel Reduction - "Intensive Zone"

The "Intensive Zone" is a component of Alternative E only. The most important aspect to reducing wildfire potential was to manage the entire project area to reduce fuels. The "Intensive Zone" treatment area did not result in additional protection of the area immediately adjacent to private land. This alternative proposes an "Intensive Zone" treatment for a width of 660 feet along the forest abutment with private property to mitigate the fire effects of not thinning any trees over 9-inches dbh and higher canopy closures over the rest of the project area. Initial attack has been quite effective against fires starting in such a fuel break. However, on this forest a 660-foot-wide fuel break has not proven to be an effective fire stop against fires approaching from beyond such a strip. An illustration is the Slate Fire (1996). An entire strike team of wildland fire engines was unable to even slow down the forward spread of the fire at any of three separate breaks similar to the "intensive zone" treatment.

Comparison of Alternatives - Issue 4: Lighter Thinning Methods

Issue: Thinning north of Kelly Canyon as described in the Proposed Action goes beyond what is needed to reduce fire risk. A lighter treatment of 60 to 120 basal area and 9-inch thinning limit (where a temporary road is needed) is requested for evaluation.

Fuel Reduction

Each of the action alternatives affects the potential for a large stand replacing fire to varying degrees. The differences of effects in meeting all of the objectives listed above are largest between Alternative E and the other action alternatives.

Alternative A has the greatest reduction in crown fire potential and severe fire behavior. Alternative A provides a higher degree of habitat protection (a fire-related objective) by reducing the probability of tree mortality more than the other alternatives (induced by both wild and prescribed fires). By reducing the probability of mortality among large trees (12 to 20-inches dbh) more than the other alternatives, this alternative is also most likely to retain and recruit mature ponderosa pine trees (a fire-related objective).

Alternative B calls for no action as stated in the existing condition section, the current fuel and vegetative conditions would be likely to generate severe fire behavior. Modeling indicated significant torching and spot fires more than half a mile ahead of a running crown fire.

Alternative C is difficult to model with precision, since relatively few trees larger than 16-inch dbh would be removed under Alternative A. The model did not indicate any difference in expected flame length or probability of large tree (12 to 20-inches dbh) mortality between Alternatives A and C. Alternative D appears to reduce the fire hazard to both the nearby communities and the forest itself as much as Alternative A. Within this project area, it provides only slightly less canopy break and almost as much reduction in fire-laddering fuel as Alternative A.

Alternative E has the least reduction in crown fire potential and severe fire behavior, but in most instances it showed improvement over the existing

condition. The fuels analysis shows that there is little difference in fire effects between the proposed thinning of 40 to 120 BA in Alternatives A, C, and D and the 60 to 120 BA thinning in Alternative E. However, the 9-inch thinning limit in Alternative E in areas where no new temporary roads were constructed resulted in unacceptable wildfire potential within 1 mile of the Forest Highlands and Kachina Village residential areas. South of Kelly Canyon, the 9-inch thinning limit maintains high fire potential threat to wildlife and T&E habitat.

Comparison of Alternatives - Issue 5: Road Issues

Issue: Temporary roads lead to increased soil compaction, transport of exotic weeds, and have long-lasting impacts on forest structure, therefore, we request that no new temporary roads be created even if only for the duration of the project.

Transportation System/ Soil Compaction and Exotic Weeds

All action alternatives intend to rehabilitate 17.65 miles of existing roadway by closing, scarifying, and re-vegetating. These areas will not likely return to full productivity for many years, but will become stable after only a few years. The area of rehabilitated roadway amounts to 43 acres.

Alternatives A, C, and D will require 5.75 miles of temporary road. Alternative E requires 2.5 to complete the “intensive zone” thinning. There was little or no difference described in effect analysis for soil compaction or transport of exotic weeds. Alternative E would result in 8 fewer acres of disturbance than other action alternatives.

The No Action Alternative results in no change.

Table 4. Miles of Temporary Roads, Road Maintenance, and Rehabilitation.

Alternative	Temporary Road	Road Maintenance	Rehabilitated
A, C, and D	5.75 miles, 14 acres	36 miles, 87 acres	17.65 miles, 43 acres
E	2.5 miles, 6 acres	36 miles, 87 acres	17.65 miles, 43 acres

Comparison of Alternatives - Issue 6: Mechanized Equipment

Issue: Mechanized equipment and excessive thinning will increase soil compaction and cause disturbance to wildlife in areas south of Kelly Canyon. The area south of Kelly Canyon should only be treated with hand thinning and was requested for evaluation.

Soil Compaction

In Alternatives A, C, and D, provided that mitigation measures described in the soil and water mitigation section are followed, there will be only minor impacts to on site soil quality and productivity from the proposed activities. Some compaction from skidding equipment will occur in all treatment areas except hand treatment.

In Alternative E, treatment acres and erosion hazard are the same as other alternatives. The difference in this alternative is that only 2,330 acres will be mechanically treated or a little over half of the other alternatives. Consequently, we can expect about half of the impacts to soil quality and productivity to occur. Provided that mitigation measures described in the soil and water mitigation section are followed, there will be only minor impacts to on site soil quality and productivity from the proposed activities.

In Alternatives A, C, and D, the combination of thinning to open the stand and burning will likely result in the promotion of herbaceous vegetation over 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. This effect will be strongly reduced in Alternative E, where thinning only to 9 inches will limit thinning treatments.

South of James Canyon the model indicated that Alternative E would not reduce flame lengths from 7.2 feet nor would it decrease tree mortality from 90(+) percent. The model indicated that a fire occurring in this zone after Alternative E was applied would almost certainly produce multiple spot fires in Kelly and James Canyons. Fires in these canyons would, in turn, generate severe fire behavior, spotting over long distances, and threatening several communities to the north. Within this southernmost zone, the probability of tree mortality would remain over 90 percent in all size classes.

Under Alternative B there are no mechanized equipment effects.

Wildlife Habitat (MIS Species)

Abert squirrel: All alternatives provide greater than 20 percent forage and cover habitat. Considering cover and forage together, Alternative B offers the best quality habitat for Abert squirrel. None of the action alternatives would greatly affect Abert squirrel.

Elk: There would be adequate cover under all alternatives. Best foraging opportunities would occur under Alternatives A, C, and D. Considering cover and forage together, all action alternatives would improve habitat quality for elk, with Alternatives A, C, and D, offering better habitat quality than Alternatives B or E.

Hairy Woodpecker: Considering cover and forage together, Alternatives A, C, and D would offer better habitat quality than Alternatives B or E. The greatest increase in VSS 5 class would occur under Alternatives A, C, and D. This class contains large trees which are recruitment trees for snags.

Northern Goshawk: Considering cover and forage together, Alternatives A, C, and D would offer better habitat quality than Alternatives B or E.

Mule Deer: Considering cover and forage together, Alternatives A, C, and D offer the best quality habitat for mule deer. Thinning of stands, creation and/or expansion of openings, and broadcast burning will stimulate understory plant growth. This would provide more forbs and browse for mule deer.

Pygmy Nuthatch: Considering cover and forage together, Alternatives A, C, and D offer the best quality habitat for pygmy nuthatch. These three alternatives would increase the percentage of late seral stages of the forest the most.

Turkey: Alternatives A, C, and D would offer the most foraging and nesting habitat based on more created openings. Openings would promote greater amounts and vigor of growth of the understory vegetation and offer more edge effect. Alternatives A, C, and D would also offer the most roosting habitat due to an increase in VSS 5 class (refer to the tables at the beginning of the wildlife section).

Conclusions

Overall, Alternatives A, C, and D would offer better habitat quality for management indicator species. The exception is with Alternative B offering better quality habitat for Abert squirrel.

High fire hazard potential would persist under Alternatives B and E. With the advent of a large wildfire, habitat for forest-dependent management indicator species would be destroyed.

Table 5. Comparison of Alternatives Based on Improving Conditions Stated in the Purpose and Need.

Purpose and Need	Alternative A	Alternative C	Alternative D	Alternative E
Reduce Potential for Stand Replacing Wildfire	Fire potential reduced on 4,266 acres with crown fire potential reduction.	Fire potential reduced on 4,266 acres with crown fire potential reduction; 16-inch dbh limit lessens effect slightly.	Fire potential reduced 4,266 acres with crown fire potential reduction; 18-inch dbh limit will have little to no effect.	Fire potential reduced on 2,328 acres; 9-inch dbh limit will not lessen crown fire potential on other acres treated.
Improve Forest Ecosystem Resilience — Wildfire, Mistletoe, and Bugs.	Ecosystem resilience improved on 4,266 acres. Dwarf mistletoe and bug infestation decreased.	Ecosystem resilience improved on 4,266 acres; 16-inch dbh limit lessens ability to treat dwarf mistletoe.	Ecosystem resilience improved on 4,266 acres; 18-inch dbh limit lessens ability to treat dwarf mistletoe slightly.	Ecosystem resilience improved on 2,328 acres. On 1,898 acres the 9-inch dbh limit will result in 50% less dwarf mistletoe and bark beetle treatment.

Table 5. Comparison of Alternatives Based on Improving Conditions Stated in the Purpose and Need (continued).

Purpose and Need	Alternative A	Alternative C	Alternative D	Alternative E
Protect Threatened, Endangered and Sensitive Species	The absence of a diameter limit effects bald eagle habitat slightly.	The 16-inch dbh limit effects development of old-growth stand conditions, and is less desirable for promoting old tree development.	The 18-inch dbh limit is better for bald eagle habitat.	The 9-inch dbh limit will result in 50% less old tree development for the future with impacts to promoting Bald Eagle habitat.
Protect Oak Creek Watershed From the Effects Of Wildfire	Most reduction in fire potential.	Reduction in fire potential, however the 16-inch dbh limit lessens wildfire reduction slightly.	Most reduction in fire potential.	The 9-inch thinning limit maintains high wildfire potential that could damage the watershed.
Protect Habitat for Species Requiring Dense Stand	Meets need due to the inclusion of cover patches and deferral along canyon rims south of Kelly Canyon.	Meets need due to the inclusion of cover patches and deferral along canyon rims south of Kelly Canyon.	Meets need due to the inclusion of cover patches and deferral along canyon rims south of Kelly Canyon.	Meets need somewhat less because the 9-inch thinning limit maintains more cover, but places the cover at high risk of loss from wildfire.
Improve Understory Productivity (Desired Condition is 10% Openings)	Grassy openings created on 10% of acres treated and canopy cover conditions improved on 30% of the project area to support a diverse understory.	Grassy openings created on about 5% of the project area. Canopy cover improves understory on 30% of the project area. The 16-inch diameter limit reduces the number of grassy openings,	With grassy openings created on 10% of acres treated and canopy cover conditions improved on 30% of the project area. The 18-inch dbh limit reduces the number of grassy openings slightly.	Grassy openings would be created on 1% of acres treated and canopy cover improved on 5% of the project area. Both the 9-inch dbh limit and 16-inch dbh limit reduce the number of grassy openings.
Enhance and Recruit Old Trees and Gambel Oak[1]	For both short and long-term management there would be an increase of 225% large diameter trees in 50 years.	For both short and long-term management there would be an increase of 225% large diameter trees in 50 years.	For both short and long-term management there would be an increase of 225% large diameter trees in 50 years.	For both short and long-term management there would be an increase of only 18% large diameter trees in 50 years.

[1] All alternatives retain all existing mature ponderosa pine trees or old "yellow-barked" trees. Temporary road or landing locations to achieve removal objectives will avoid large diameter trees where possible.

Table 5. Comparison of Alternatives Based on Improving Conditions Stated in the Purpose and Need (continued).

Purpose and Need	Alternative A	Alternative C	Alternative D	Alternative E
Improve Conditions for Natural Fire	Treatments reduce wildfire potential to work toward natural fire cycles.	Treatments reduce wildfire potential to work toward natural fire cycles.	Treatments reduce wildfire potential to work toward natural fire cycles.	The treatments do not reduce wildfire potential to work toward natural fire cycles on approximately 50% of the project area.
Improve Vegetative Structural Stage (VSS) Distribution[2]	VSS 5 (27.5%) and 6 (4.5%) structural stages nearly meeting VSS 5 and 6 conditions of northern goshawk guidelines in 50 years.	VSS 5 (27.5%) and 6 (4.5%) structural stages nearly meeting VSS 5 and 6 conditions of northern goshawk guidelines in 50 years.	VSS 5 (27.5%) and 6 (4.5%) structural stages nearly meeting VSS 5 and 6 conditions of northern goshawk guidelines in 50 years.	VSS 5 (10%) and 6 (3%) structural falling considerably short of meeting VSS 5 and 6 conditions of northern goshawk guidelines in 50 years.
Manage Roads, and Recreation to Decrease Fire Starts, and to Better Balance Human Uses With Wildlife Habitat and Watershed and Soil Conditions	All alternatives change some areas to day-use recreation only, adjust dispersed camping to designated sites in some areas, identify and construct trails and trailheads, maintain some roads and close others. Where actions occur, wildlife habitat, soil, and watershed resources are improved. Risk of human-caused wildfire is reduced.			
Improve Riparian Habitat at Kelly Seep	All alternatives improve riparian habitat at Kelly Seep.			
Provide Wildlife Cover Movement Corridors	All alternatives contain dense forest cover habitat and a wildlife movement corridor is maintained.			
Protect Cultural Sites[3]	Potential damage to sites from wildfire is reduced on 4,266 acres.	Potential damage to sites from wildfire is reduced on 4,266 acres with crown fire potential reduction; 16-inch dbh limit will affect slightly.	Potential damage to sites from wildfire is reduced on 4,266 acres.	Potential damage to sites from wildfire is reduced on 2,328 acres.

[2] The need for fire reduction resulted in improvement of VSS distribution among VSS 3, 4, 5 and 6. VSS 1 and 2 remain mostly unchanged under all alternatives.

[3] All project activities follow mitigation measures designed to protect cultural sites.

Chapter 3 • Affected Environment and Environmental Consequences

Introduction

This chapter provides information concerning the existing environment of the Kachina Village Forest Health Project area and potential consequences to that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in Chapter 2. Each resource potentially affected by the Proposed Action or alternatives is described in terms of its current condition and uses. These resource descriptions also include descriptions of and reasons for the spatial and temporal boundaries of cumulative effects analyses. Existing baseline, or benchmark, conditions and possible thresholds are also indicated.

Following each resource description is a discussion of the potential effects (environmental consequences) to the resource associated with the implementation of each alternative. All effects—including direct, indirect, and cumulative effects—are disclosed. Effects are quantified, where possible, and qualitative discussions are included. The means by which potential adverse effects will be reduced or mitigated are described in Chapter 2.

The discussions of resources and potential effects take advantage of existing information included in the Forest Plan's EIS, EIS's from other projects, 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 Kachina Village Forest Health Project includes all project-specific information, including resource reports, the watershed analysis, and other results of field investigations. The record also contains information resulting from public involvement efforts. The planning record is located at the Peaks Ranger District office in Flagstaff, Arizona, and is available for review during regular business hours.

Assumptions for This Analysis

Throughout this chapter the reference to "wildfire" equals a high intensity crown fire. There are many kinds of wildfire depending on weather and fuel conditions. Low intensity crown fires are normally suppressed and do not contribute extensively to the future condition of the project area. These effects sections describe the effects of high intensity wildfire that could change future conditions of the area.

Projects identified in the cumulative effects analysis are different depending on the resource discussed. Table 6 on the following page describes projects that were considered in this document by one or more of the resource specialists. Long past projects are not listed as they contributed to forest conditions described under the affected environment sections.

The Flagstaff/Lake Mary Ecosystem Analysis (FLEA) is not listed as a cumulative project because this project does not propose any on-the-ground activities. The FLEA project proposes to amend the Forest Plan. The Kachina Village FHP contains site-specific actions that meet current Forest Plan direction.

Analyzing Effects

Environmental consequences are the effects of implementing an alternative on the physical, biological, social, and economic environment. The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) includes a number of specific categories to use for the analysis of environmental consequences. Several are applicable to the analysis of the proposed project and alternatives and form the basis of much of the analysis that follows. They are explained briefly here.

Direct, Indirect, and Cumulative Effects

Direct environmental effects are those occurring at the same time and place as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity, but would be considerable in the foreseeable future. Cumulative effects result from incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor, but collectively major, actions taking place over a period of time.

Unavoidable Adverse Effects

Implementation of any action alternative that would cause some adverse environmental effects that cannot be effectively mitigated or avoided. Unavoidable adverse effects often result from managing the land for one resource at the expense of the use or condition of other resources. Many adverse effects can be reduced, mitigated, or avoided by limiting the extent or duration of effects. The interdisciplinary procedure used to identify specific practices was designed to eliminate or lessen adverse consequences. The application of Forest Plan standards

Table 6. Projects Considered in Cumulative Effects Analysis

Name	Timing	Activities	Area
Pumphouse Multiproduct Timber Sale	Past	Thinning, pile burning, broadcast burning	1,359 acres adjacent to Kachina Village FHP.
ADOT Tree Removal along	Ongoing	Removal of most trees within a 30-foot area or the right-of-way fence	Both sides of Highway 89A through Kachina Village FHP.
Griffiths Spring Parking and Interpretitive Trail	Ongoing	Parking area, toilet and trail.	Griffiths Spring, 1 mile of trail and 1/4 acre parking
Airport Fuels Reduction Project (broadcast burning only)	Forseeable Future	Broadcast burning	1,000 acres northeast of Kachina Village FHP (approximately 200 acres within Kachina Village FHP boundary)
I-17 Wireless Communication Tower at James Canyon	Forseeable Future	Construct tower	1/4 acre
Fort Tuthill to Kachina Village Trail	Forseeable Future	Nonmotorized trail	3 miles
Oak Creek Canyon Fuels Reduction Project	Forseeable Future	Thinning, pile burning; broadcast burning, brush crushing.	Interior of Oak Creek Canyon outside of wilderness boundaries.
State Section 26 (1/2)	Ongoing	Thinning, pile burning	320 acres
Development of Previously Undeveloped Private Land	Ongoing; currently being developed.	Residential development	Section 24 (640 acres)
Maintenance activities on National Forest Roads, Facilities and Trails	Ongoing	Grading, culverts, painting, and signing.	In and around the Kachina FHP.
Illegal Firewood Cutting	Ongoing; low levels	Large diameter green trees cut.	In and around the Kachina FHP.
Recreation Activities	Ongoing	Hiking, biking, horseback riding, ATV, rock climbing, picnicking, camping, etc.	In and around the Kachina FHP.

and guidelines, Best Management Practices, project-specific mitigation measures, and monitoring are all intended to further limit the extent, severity, and duration of potential effects. Such measures are discussed throughout this chapter and are discussed in Chapter 2. Regardless of the use of these measures, some adverse effects will occur. The purpose of this chapter is to fully disclose these effects.

Short-term Use and Long-term Productivity

Short-term uses and their effects are those that occur annually or within the first few years of project implementation. Long-term productivity refers to the capability of the land and resources to continue producing goods and services long after the project has been implemented. Under the Multiple-Use Sustained-Yield Act and the National Forest Management Act, all renewable resources are to be

managed in such a way that they are available for future generations. Harvesting and use of standing timber is an example of short-term use of a renewable resource. This long-term productivity is maintained through the application of the resource protection measures described in Chapter 2, in particular those applying to soil and water resources. These are also discussed throughout this chapter, particularly in terms of wildlife habitat, TE&S habitat, development of old-growth, wildfire potential, and overall forest health goals.

Irreversible and Irretrievable Commitments

There are no irreversible or irretrievable commitments associated with this project. Irreversible commitments are decisions affecting non-renewable resources such as soils, wetlands, unroaded areas, and cultural resources. Such commitments are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense, or because the resource has been destroyed or removed.

Available Information

There is less than complete knowledge about many of the relationships and conditions of wildlife, fish, forests, jobs, and communities. The ecology, inventory, and management of a large forest area are a complex and developing science. The biology of wildlife species prompts questions about population dynamics and habitat relationships. The interaction of resource supply, the economy, and communities is the subject matter of an inexact science. However, the basic data and central relationships are sufficiently well established in the respective sciences for the deciding official to make a reasoned choice between the alternatives and to adequately assess and disclose the possible adverse environmental consequences. New or improved information would be very unlikely to reverse or nullify these understood relationships.

Plans of Other Agencies

The Kachina Village Project does not conflict with objectives of other Federal, state, and local land use plans, policies and controls for the area. The Council for Environmental Quality regulations implementing NEPA require a determination of possible conflicts between the Proposed Action and the objectives of Federal, state, and local land use plans, policies, and controls for the area.

Aesthetics

In addition to inventory revisions directed by the Forest Plan, the Forest Service is required to begin using the Scenery Management System (SMS) to replace concepts and terminology of the Visual Management System (VMS). In lieu of a forest-wide revision, following is an assessment of the project area using SMS terminology and concepts. Many of the SMS concepts are borrowed from the VMS so the inventory and analysis updates are similar. The major difference between the two systems relevant to this analysis is the addition of a more complete discussion of "landscape character" with the SMS. An expanded discussion of landscape character suitable for an SMS analysis is included in the following section. Inventory and analysis required for implementing the SMS is scheduled to coincide with the next Forest Plan revision (scheduled to begin 2006).

Affected Environment Landscape Character and Scenic Integrity

The Landscape Character Description, as defined in "Landscape Aesthetics - A handbook for Scenery Management" (USDA Handbook 701) describes the positive scenic and cultural elements inherent to the landscape that collectively form the base for comparison of alternative management scenarios. Landscape management that tends to preserve or enhance the inherent positive scenic elements will maintain or increase the scenic integrity of the landscape and will help achieve landscape character goals. Landscape management that eliminates or obscures positive scenic elements or that introduces elements that are visibly alien to the characteristic landscape will degrade scenic integrity and thwart achievement of landscape character goals.

Appendix F contains definitions and explanation of landscape character, including a history of this landscape.

Overall, the landscape within the analysis area appears slightly altered but with the natural appearing landscape dominating. This equates to a moderate to high level of scenic integrity. Alterations to the natural appearing landscape within the project boundary (including private lands) includes the presence of roads and trails, power lines, residential developments, including the Kachina and Forest Highlands subdivisions, and a cell tower. Except for roads and trails, most of these structures are on private land. This assessment will not include any further analysis of private lands within

the project area. Over the past several years increased recreation use of areas adjacent to Kachina and Forest Highlands subdivisions, along portions of FR 237, and in the Mexican Pocket area, have resulted in increasing visible evidence of human activity such as fire rings, compacted bare ground, litter, and additional unauthorized roads and ATV tracks. All of these additional elements in the landscape detract from its natural appearance and degrade the scenic integrity of the area, resulting in a "low" scenic integrity rating that equates to a "Modification" Visual Quality Objective (VQO)[5] at best for the specific areas affected. These more heavily impacted areas, though most visible because of proximity to major roads and access sites, make up a small percentage of the project area.

In contrast, most of the project area located away from the residential areas and high use forest areas have high scenic integrity that equates to the prescribed Retention[6] and Partial Retention[7] VQO's defined in the Forest Plan. Past management has altered the vegetative pattern from the more desirable open pine stands with more big trees to the present less desirable condition with more dense stands of smaller trees. Although the resulting landscape looks unaltered and natural to the casual observer and meets the original VQO's set forth in the Forest Plan, the existing scenic condition falls far short of the potential scenic values inherent in the historic ponderosa pine forest with its open parks dominated by large yellow-barked trees.

The canyons that occur in the area (James and Kelly Canyons and Pumphouse Wash) are mostly not accessible to motorized vehicles and bicycles and are often difficult for pedestrians to negotiate. The canyon vegetation is more diverse and not as fire dependent as the ponderosa pine forests which occur on top of the plateaus between the canyons. The resulting appearance of the canyons is generally primitive with little evidence of human activity and influence, and with vegetation that probably looks very similar to what it has looked like since people first arrived in the area. The existing scenic condition of the area canyons probably comes close to meeting the full potential for scenic quality inherent to such canyon settings within the Flagstaff Character Type. This equates to the prescribed Retention Visual Quality Objective in the current Forest Plan.

Landscape Character Goals

A landscape character goal is an objective for the overall scenic character of the landscape. There is no present direction in the Forest Plan defining any landscape character goals for the Coconino NF. There is language in the Plan directing that, forest-wide, changes to any VQO will be limited to plus or minus 15 percent. The intent of this direction was to maintain the natural appearing landscape character that existed at the time the Plan was developed (mid 1980's). In lieu of a designated landscape character goal defined in the Forest Plan, this analysis will assess the affect of the alternative actions on what we can reasonably discern to be people's preferences for landscape character based on existing research and professional experience.

Scenic Integrity Goals

Visual Quality Objectives defined in the Forest Plan for the area include:

- **Retention** along the Interstate 17 and Highway 89A road corridors within the foreground viewing position (up to 1/2 mile distance), which allows for no visible evidence of management activity or human alteration;
- **Modification**[8] in areas unseen from roads and trails, which allows for visible alterations to the natural appearing landscape that blend with the natural appearing landscape; and
- **Partial retention** for the westernmost extent of the plateau between James and Kelly Canyons, which allows for alterations to the natural appearing landscape which are subordinate to the landscape character.

The Forest Plan calls for an update of the initial VQO inventory at the time of project analysis. An updated inventory has been completed and the

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[5] Visual Quality Objectives (VQO's) are desired levels of visual quality based on the physical and sociological characteristics of an area. VQO's refer to the degree of acceptable alterations of the characteristic landscape.

[6] Retention is a degree of alteration in which management activities, in general, are not evident to the casual forest visitor.

[7] Partial Retention is a degree of alteration in which management activities, in general, may be evident but must remain subordinate to the characteristic landscape.

[8] Modification is a degree of alteration in which management activities may dominate the characteristic landscape but must, at the same time, use naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in the middleground or background.

result is: 1) Retention VQO areas would remain the same; 2) Partial Retention areas would remain the same; and 3) Modification areas would change to Partial Retention. By selecting one of the action alternatives, the decision maker adopts the new VQO inventory.

Impacts to visual quality objectives from the alternatives are assessed based on the updated inventory.

All "action" alternatives (all alternatives except the "No Action" alternative, Alternative B) would change the landscape character of the area by thinning out the forest. Research and observation both suggest that a forest with fewer trees than now exists across much of the Colorado plateau will generally be more aesthetically pleasing to most people (Brown and Daniel, 1984).

Direct Effects of Alternative A

Alternative A will result in a landscape that will experience disruptions of existing scenic integrity beginning with thinning activities and persisting until thinning slash and other evidence of thinning activity is sufficiently reduced. Some Partial Retention VQO areas will shift to Modification during this short-term period of time. In areas where thinning slash is aggressively removed or burned, as is typically done along some sections of highway or major road corridor, scenic integrity will generally be reduced for 1 to 3 years following tree cutting. In areas with less aggressive slash treatment, which includes the majority of the project area, evidence of thinning activities will likely persist for 3 to 5 years decreasing considerably as prescribed burns reduce the presence of "red" slash and stumps. Prescribed burning and natural processes will most likely reduce the slash throughout the area so that most forest visitors do not notice it 5 years after the thinning.

The west side of the I-17 corridor would receive thinning of smaller diameter trees consistent with the forest beyond the right-of-way. The result would be a relatively consistent appearing landscape character on both sides of the right-of-way fence that would be more pleasing in appearance to most people than Alternative B (No Action).

Broadcast burning will result in disruption of the scenic integrity immediately following the burn and until vegetation re-sprouts in the area (usually 1 to 3 months). Some blackened bark may remain on the base of trees. Partial Retention VQO's may shift to Modification during this short-term time period. The visual affect is for only a portion of the Kachina Village Project area at one time, because different burn blocks[9] will be treated on different years. The amount of seen area will depend on the major roads or trails adjacent to the burn block.

Visual access into the forest landscape will be greatly increased immediately following treatment revealing more landform and vegetative features in the landscape. It will result in a more diverse vegetative mosaic that will generally be less dense and more transparent and, therefore, more interesting to the typical person viewing it than the present scenic condition.

Recreation activities described in Alternative A and common to all of the action alternatives will reduce the visible impacts of heavy recreation use along FR 237 and some of the other road sections identified in the recreation report (PRD 137b). This improvement occurs immediately after activities occur. The fence at Kelly Seep will surround a very small area and affect only that site.

Direct Effects of Alternative B

There are no direct effects to scenic integrity from the "no action" alternative.

Direct Effects of Alternative C

The direct effects of Alternative C are similar to Alternative A (Proposed Action) but with several more trees per acre less than 16 inches removed. The result will be a slightly more transparent and open forest than the Proposed Action, as seen from the perspective of someone viewing it from ground level. This occurs immediately after thinning treatments.

The direct effects of recreation management activities, broadcast burning, and the I-17 corridor are the same as Alternative A.

Direct Effects of Alternative D

The direct effects of Alternative D are similar to those described for Alternative A (Proposed Action). The direct effect on scenic integrity would be the

[9] Burn blocks is an informal term used to describe areas of land, usually roughly 100-500 acres in size that are burned in a given year or single entry. Roads, utility lines, or fire line usually bound burn blocks.

same as Alternative A except that there would be a small number (estimated to be about 2,000 trees in this category total across roughly 4,500 treated acres, or 1 tree per 2.25 acres) of black-barked trees larger than 18 inches left standing with this alternative that would be cut in Alternative A. Consequently, there would be slightly more smaller diameter trees cut to meet fire reduction basal area objectives resulting in slightly more "transparency" to the forest setting, as seen from ground level. There would also be one additional large "recruit" tree for every 2.25 acres that would "soon" be a large yellow-barked tree (normally within 40 to 60 years for a typical 18 inch tree on a good site).

The direct effects of recreation management activities, broadcast burning and the I-17 corridor are the same as Alternative A.

Direct Effects of Alternative E

This alternative would result in more stems per acre remaining after treatment than Alternative A. Many stands with larger trees predominant would not be thinned at all. As a result there will be less disruption of the existing scenic condition, and less slash to dispose of (except for within the "Intensive Zone") throughout the treated stands. This alternative would meet standards for the prescribed Partial Retention VQO (moderate scenic integrity) in all treatment areas except the "Intensive Zone", where it would only meet standards for a Modification VQO (low scenic integrity) due to the contrast with adjacent stands and due to the geometric shape of the "Intensive Zone". This affect occurs immediately after thinning treatment. The direct effects of recreation management activities, broadcast burning and the I-17 corridor are the same as Alternative A.

Indirect Effects of Alternative A

Alternative A will help the area attain its long-term scenic potential by increasing the viability of older trees, increasing the growth rate of smaller trees, and by creating and maintaining a more diverse and more interesting vegetative pattern mosaic across the affected landscape. The ability of the landscape to reach the maximum inherent scenic potential that existed historically will be enhanced with this alternative. The presence of grassy openings, created by this alternative will add to the scenic quality.

A long-term effect of recreation management activities and broadcast burning is to also help the area attain its long-term scenic potential.

The risk of a running crown fire is lowest in Alternative A.

Indirect Effects of Alternative B

The No Action Alternative results in a vegetative pattern that tends to decrease the viability of larger, older trees and to favor conditions that result in dense stands of smaller diameter trees. Crowding by smaller trees for moisture and nutrients will tend to accelerate mortality in the larger trees, as well as to put them at risk of mortality by wildfire. The long-term result will likely be a decrease in the number and extent of large "yellow pine" across the landscape. The ability of the landscape to reach the maximum inherent scenic potential that existed historically will be compromised with this alternative compared to Alternative A.

Continuation of existing recreation dispersed camping and social trail use will continue creating pockets of landscape with compacted bare soil, fire rings and redundant roads and trails. In these places scenic integrity will trend downward over time.

The potential for large fires occurring within the Kachina area, though reduced considerably from the existing condition, would be higher for this alternative than for the action alternatives (A, C, and D). A large crown fire could either add interest to the landscape or decrease its scenic value depending on the configuration and extent of the burned area. However, the other risk is that an especially large, hot crown fire could reduce the mosaic to a simple burned landscape, reducing the mosaic effect and producing a much less complex and much less appealing landscape pattern.

The risk of a running crown fire is greater in Alternative B than any of the action alternatives.

Indirect Effects of Alternative C

The indirect effects of Alternative C are similar to Alternative A, except that this alternative will result in a large number of possible "recruitment" trees for the next generation of yellow-barked dominant trees, but will tend to more severely thin out the smallest trees in a stand. Lack of sufficient thinning within stands presently dominated by trees 16 inches and larger will slow the growth of the trees and, therefore, slow the rate of "recruitment" in the stands to a small degree.

Forest canopies would tend to remain closed where larger trees are now predominant which will tend to reduce ground cover production on some sites. The resulting diversity of forest settings, from closed canopy stands of large and mid-sized trees, to both open stands and dense stands of smaller trees, interspersed with the prescribed openings and dense groups, would be an interesting vegetative composition resulting in generally good visual access into the forest. It is a small number of trees that would be retained under Alternative C and cut under Alternative A (estimated at about 7,000 trees or about 1.5 trees per treated acre). This number results in a relatively minor effect to total landscape character over the long and short term; however, since the 7,000 trees affected are not distributed evenly over the landscape, the effect on some sites could be noticeable.

Long-term effects of recreation management activities and broadcast burning is to also help the area attain its long-term scenic potential.

The risk of a running crown fire is somewhat greater than Alternative A and less than Alternative B.

Indirect Effects of Alternative D

The indirect affects of Alternative D are almost identical to Alternative A. The small number of trees greater than 18-inch diameter that are retained under this alternative are likely to turn yellow within 20 to 60 years and as such represent an investment in future scenic value. There would be a minor acceleration in the number of black-bark "recruits" within this size class to replace aging yellow-bark pine as they die. The small number of trees that would be retained under Alternative D and cut under Alternative A (estimated at about 2,000 trees or about 1 tree per 2.25 treated acres) results in a relatively minor effect to total landscape character over the long and short-term; however, since the 2,000 trees affected are not distributed evenly over the landscape, the effect on some sites could be noticeable.

Long-term effects of recreation management activities and broadcast burning is to also help the area attain its long-term scenic potential.

The risk of a running crown fire is similar to Alternative C.

Indirect Effects of Alternative E

This alternative would lead to improvements to the long-term landscape character, but would result in less change than the other action alternatives mainly due to the reduced growth rate on the remaining trees that could be expected following treatment in comparison to the action alternatives. The ability of the landscape to reach the maximum inherent scenic potential that existed historically will be enhanced with this alternative, but not to the extent of other action alternatives (Alternatives A, C, and D).

This alternative would be more at risk for stand replacement wildfires than Alternatives A, C, and D. The diverse pattern that this thinning regime would produce is more likely to result in a burned area mosaic that would add a high degree of scenic interest to the landscape. However, the other risk is that an especially large, hot crown fire could reduce the mosaic to a simple burned landscape, reducing the mosaic effect and producing a much less complex and much less appealing landscape pattern. The risk of a running crown fire is greater in Alternative E than Alternatives A, C, and D and the risk of such a fire is less than Alternative B.

Conclusion: All of the action alternatives have very similar effects on recreation settings throughout the Kachina area primarily because they would all adopt the same transportation plan which would close out many of the non-system roads and roads that are in excess of those needed for administrative or recreation access. Decreasing road densities in some areas where they exceed the 2 miles per square mile density objective from the Forest Plan will help retain or expand semi-primitive characteristics to counter the expansion of Roaded Natural characteristics over the past 2 decades.

People will tend to prefer the appearance of the landscape resulting from the action alternatives, compared to what will result from Alternative B (No Action), and will tend to use that landscape more as a result.

Cumulative Effects of Alternative A

Areas chosen for cumulative effects analysis are those projects immediately adjacent to the Kachina Village Project. Projects in the distant past have contributed to the existing condition as described in the preceeding affected environment section and in Appendix F. One recently completed project—the

Pumphouse Multiproduct Timber Sale—resulted in some thinning from below. Combined with the Kachina Village Project, there is an enhancement of the ability of the landscape to reach maximum inherent scenic potential that existed historically. The presence of grassy openings created by this Alternative A will add to the scenic quality. Recently, ADOT removed trees extensively along the Highway 89A corridor. At this time, there is little blending of these activities with the forest beyond. The action alternatives will thin up to the right-of-way fence in some locations, enhancing visual quality by blending the roadway edge with the forest. The Airport Fuels Reduction Project on the northern boundary of the Kachina Village Project will receive broadcast burning that will have the same short-term impacts and long-term future conditions and broadcast burning in the Kachina Village Project area.

Alternative A (Proposed Action) will result in landscape patterns that will blend with other local vegetative patterns resulting from these management initiatives and trends to help create a more scenic landscape character for the Flagstaff Character Type in the long term.

Alternative A (Proposed Action) will have a cumulative effect on the view from I-17 and Highway 89A in that thinning smaller diameter trees will help blend ongoing and future ADOT thinning initiatives along the highways.

Cumulative Effects of Alternative B

The visual effects of a high intensity crown fire, as described under indirect affects of Alternative B, would result in a dramatically different landscape than surrounding areas. There would be a sharp contrast at the border of a wildfire area.

Cumulative Effects of Alternative C

There is very little difference between Alternatives A and C.

Cumulative Effects of Alternative D

There is very little difference between Alternatives A and D.

Cumulative Effects of Alternative E

This alternative will not blend with other wildland-urban interface initiatives nor with ADOT right-of-way thinning, as well as the other action alternatives in the areas south of Kelly Canyon where cutting no trees over 9 inches dbh would occur. Cutting only lower diameter trees limits flexibility for creating openings or clumpiness which add scenic quality.

Conclusion: Alternative A (Proposed Action) will generally enhance the scenic quality of the affected landscape considerably more than continued implementation of the No Action Alternative (Alternative B – existing management). The difference in scenic quality between the two alternatives will increase over time as the vegetative pattern favored by the Alternative A management scenario matures. Alternatives C and D are very similar to Alternative A in their effects on both scenic integrity and landscape character. Alternative D is slightly more desirable for landscape character concerns than Alternative A because of the retention of a few more of the largest black-bark pine in the stands, which could be a major factor in a few sites. Alternative C is slightly less desirable than Alternative A for long-term landscape character concerns because, even though more of the larger black-barked trees are retained, some of the existing large tree clusters will not be thinned enough to increase the viability of existing large trees at those sites. Alternative E is the least disruptive of the action alternatives, except for the “intensive zone” adjacent to the Kachina community which is the most visually discordant element proposed for any of the alternatives. Alternative E does the least to enhance long-term landscape character except for Alternative B. Alternative E introduces a large discordant element into the landscape (the “Intensive Zone”) and falls far short of Alternatives D, A, and C in enhancing long-term landscape character.

Air Quality

Affected Environment or General Air Quality

The prevailing winds for this project area are out of the southwest. However, as fronts pass, winds can arrive from any compass direction for a period ranging from a few hours to 2 or 3 days. The area is not prone to inversions, but inversions do occur more between October and December than at other times of the year. Stable atmospheric conditions, when they occur, may last from 12 hours to 6 or 7 days at a time.

The Kachina Village Project area is located within the Verde Airshed and downwind activity occurs within this airshed only. There are no non-attainment areas[10] or Class 1 airsheds[11] within this airshed.

Flagstaff and its surrounding communities lie to the north and northeast (approximately 2 to 6 miles) from the project area. The communities of Kachina Village and Forest Highlands are immediately adjacent to the northern boundary of the project area. Another area, Oak Creek Canyon, is smoke sensitive because it conveys a large number of tourists through regionally popular vistas. Oak Creek Canyon lies to the southwest of the project area (approximately 2 to 10 miles). Two highway corridors border the project area. They are I-17 and Highway 89A. Traffic is constant along both of these highways. There is a high level of recreation activities, especially in the summer months, within portions of the analysis area.

Air quality surrounding the project area is generally good. However, smoke from wood-burning stoves and automobile exhaust from commuter traffic can be seen at times during the winter months. Prescribed burning from other fuels treatment projects generates emissions that must be balanced with the air mass' ability to disperse on any given day.

All forest burning activities are regulated and administered by Article 15, Forest and Range Management Burn Rules (10/8/96). The Arizona Department of Environmental Quality (ADEQ) strictly models emissions/pollutants from all prescribed burning within the state. Any prescribed burn planned by the Forest Service must be approved by ADEQ on a daily basis. ADEQ will not allow more acres burned per day, per airshed, than is acceptable with current air quality conditions. The burn boss is responsible for monitoring smoke plume trajectories to assure impacts are within predicted values. The burn boss will make changes as needed when unpredicted weather changes threaten stronger impacts.

Each of the action alternatives seeks to reduce the fire hazard while retaining as many nutrients on site as possible. Each of the action alternatives proposes burning the piled thinning slash (4,804 acres), as well as prescribed burning of the forest floor (6,229 acres). Generally, emissions from prescribed fires can be controlled within acceptable limits while emissions from a wildfire tend to exceed air quality standards in both quantity and duration.

Direct Effects of Alternative A

Emissions generated by the alternatives have been estimated and all modeled emissions would meet National and State Ambient Air Quality Standards. Calculations are located in the project record file.

Smoke from prescribed burning will have short-term impacts on local air quality. Effects occur in two forms: 1) pile burning of slash generated from thinning trees, and 2) broadcast burning the forest floor in small blocks.

Direct Effects of Pile Burning for Alternative A

Pile burning is relatively efficient combustion producing far fewer emissions than broadcast burning. Broadcast burning of the forest floor produces considerably more emissions but is more beneficial to the forest environment. Finally, a wildfire burning through the current fuel conditions produces the greatest amount of emission levels and the most destructive effects.

Under Alternative A, thinning slash shall be piled for burning. Based on current conditions we expect the following tons per acre of fuel to be generated by each of the thinning prescriptions (see Table 7). Approximately 20 percent of this slash would be left on the ground to meet Best Management Practices for soil and watershed health. The balance of the slash would be piled and the piles would be burned under conditions meeting air quality standards.

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[10] The EPA has established NAAQ's for specific pollutants emitted in significant quantities throughout the country that may be a danger to public health and welfare. These pollutants are called criteria pollutants. The NAAQ's are designed to protect human health and the public welfare. The Clean Air Act defines public welfare effects to include, but not be limited to, "effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being." If a community or area does not meet or "attain" the standards, it becomes a non-attainment area and must demonstrate to the public and EPA how it will meet standards in the future. This demonstration is done through the State Implementation Plan.

[11] Designation as a Class 1 area allows only very small increments of new pollution above already existing air pollution levels. Examples include Congressionally designated wilderness areas.

Piles can be burned during rain and snowstorms with excellent smoke dispersion and little diurnal[12] smoke flow into the canyons. Proper pile burning consumes a majority of the fuels before atmospheric cooling begins leaving a small volume of fuel to produce smoke for nighttime subsidence flows.

Smoke from pile burning may subside into upper Oak Creek Canyon area. Pile burning immediately adjacent to subdivisions may cause short-term (1 day) smoke impacts to the subdivision. Public notification of burning will take place prior to ignition.

The high levels of recreation activity that occur in the summer months is not likely to be impacted by smoke because burning is not likely to occur during these times. Fire personnel are usually busy with fire suppression activities in the summer. Hunters and other people recreating in the project area in the fall and spring could be impacted by smoke from burning.

Direct Effects of Broadcast Burning for Alternative A

The initial broadcast burning of each block in the Kachina Village Project will generate smoke for as long as 72 hours after ignition. Successive broadcast burns on a given block (initiated to mimic the 3 to 15-year natural burning cycle) will generate far less smoke volume and have virtually no smoke after sunset of ignition day.

Smoke plume trajectories indicate that Kachina Village, Forest Highlands, I-17, Highway 89A and the upper portions of Oak Creek Canyon may be impacted by smoke when burning. Short-term air quality degradation and reduced visibility may be experienced in the smoke plume trajectories. After sunset, cooling atmospheric conditions will carry smoke down drainages like water flows. Under Alternative A, these down canyon flows may reach upper Oak Creek Canyon in the early morning hours. These nighttime flows may carry smoke down Kelly or James Canyon and reduce visibility along portions of I-17 and Highway 89A adjacent to the project area. These portions will be posted with appropriate signs warning motorists of reduced visibility. Ignition of each days block would be completed in the afternoon, thus limiting the smoke generated after atmospheric cooling begins.

The highest levels of recreation use occur in these summer months when broadcast burning is less likely to occur because fire management personnel are usually busy doing fire suppression at that time. Hunters and other people recreating in the project area may be displaced for a short time due to burning activities.

Direct Effects of Alternative C

Alternative C is similar to Alternative A, but does not thin any trees greater than 16-inches dbh. The difference in Alternative C is difficult to model with precision, since relatively few trees larger than 16-inches dbh would be removed under Alternative A and retained under Alternative C. The amount of thinning slash generated and the emissions produced by pile burning are only slightly less than Alternative A (included in Table 7 for Alternative A Direct Effects).

Direct Effects of Alternative D

Alternative D is similar to Alternative A with the addition of no trees greater than 18-inches dbh being thinned. The difference is difficult to model with precision since relatively few trees larger than 18-inches dbh would be removed under Alternative A that would be retained under Alternative D. The amount of thinning slash generated and the emissions produced by pile burning is between Alternatives C and A (included in Table 7 for Alternative A Direct Effects).

Table 7. Slash Generated for Alternative A.

Thinning Prescription	Thin No Larger Than 9-inch dbh	Thin Between 40-120 BA	Thin Between 40-100 BA	No Thinning; Burn Only
Approximate Acres	681	2,342	1,781	1,425
Slash Generated Tons/Acre	8	13	14	None generated

[12] Occurring during the day

Direct Effects of Alternative E

Table 8 displays the average amount of thinning slash generated by each prescription of this alternative. The sum of these acres (including the 1,425 acres that are no cut, burn only) would be broadcast burned and receive recurring maintenance burns.

As in the other action alternatives, approximately 20 percent of this slash would be left on the ground to meet Best Management Practices for soil and watershed health. The balance of the slash would be piled and the piles would be burned under conditions meeting air quality standards.

Broadcast burning could be conducted without violating air quality regulations, although more frequent maintenance burning would be necessary. This causes an increase in the number of individual days that people may experience the short-term smoke impacts described under the other action alternatives.

Indirect Effects of Alternative A

Alternative A has the greatest reduction in crown fire potential and severe fire behavior over time. The reduction in the fuel load and the increased openness of the canopy will allow future broadcast burning under a wider range of weather conditions than the other alternatives. Having a wider range of weather conditions in which to burn increases the ability of burn managers to limit undesirable smoke impacts.

Indirect Effects of Alternative B

As stated in the existing condition section, the current fuel and vegetative conditions would be likely to generate severe fire behavior. The modeling indicated that a wildfire starting as far as 2 miles from the residential areas could exceed 1,000 acres. Modeling also indicated that such a fire would exceed air quality standards.

Alternative B calls for no action. There would be no emissions except from wildfires that occur. Should a wildfire occur, the amount of fuel consumed and the smoke generated would be geometrically greater than that of the action alternatives. The resulting smoke would spread wider and farther than under controlled burning. Nighttime smoke impacts would reach farther and be more severe and could impact the smoke sensitive areas of lower Oak Creek Canyon. Smoke impacts from a wildfire would extend for more days and nights than under the action alternatives.

Should a wildfire occur, there could be bare soil areas that, when exposed to wind, would continue to produce air pollutants (ash and dust) until precipitation sealed the surface.

Indirect Effects of Alternative C

The difference in Alternative C is difficult to model with precision, since relatively few trees larger than 16-inches dbh would be removed under Alternative A and retained under Alternative C (7,000 trees). Alternative C is somewhat less effective in preventing a wildfire that would exceed air quality standards. The resulting forest condition would allow prescribed burning under a narrower range of weather conditions than Alternative A.

Indirect Effects of Alternative D

Alternative D may be slightly less effective in reducing crown fire potential and severe fire behavior than Alternative A and slightly more effective in reducing crown fire than Alternative C. The difference is difficult to model with precision, since relatively few trees larger than 18-inches dbh would be removed under Alternative A and retained under Alternative D. The resulting condition would provide a slightly narrower range of weather conditions appropriate for burning than Alternative A and a slightly wider range than Alternative C.

Table 8. Slash Generated for Alternative E.

Thinning Prescription	Thin No Larger Than 9-inch dbh	Thin Between 40-120 BA	Thin Between 40-100 BA	No Thinning; Burn Only
Approximate Acres	2,475	1,889	439	1,425
Slash Generated Tons/Acre	8	13	14	None generated

Indirect Effects of Alternative E

Alternative E has the least reduction in crown fire potential and severe fire behavior, but in most instances it showed improvement over the existing condition (Alternative B). Emissions from the model-generated wildfire in this project area exceeded air quality standards in both quantity and duration.

This alternative results in a higher percentage of closed canopies. Prescribed burning weather conditions would have a considerably narrower range than the other action alternatives making it considerably more difficult to prescribe burn without undesirable smoke impacts. At the same time by retaining more trees per acre, this alternative would tend to accumulate forest floor fuels more quickly than the other action alternatives. This in turn would require more frequent maintenance burning. This increases the number of individual days the airshed is impacted.

Cumulative Effects of Alternative A

There are many prescribed burning projects that have occurred or are planned to occur within the Verde River airshed. However, ADEQ has and will monitor the amount of acres being burned in each airshed on each day. ADEQ does not allow acres burned per day to exceed limits that will lead to excessive air quality degradation. The cumulative effect of this project is to add to the list of requested burn days and increase competition between project areas for those days.

Burning activities on the Kachina Village Project will add to the air quality effects of wood burning stoves, car emissions and other influences from developed private lands. These cumulative effects are short term and so the added effect is not significant.

Projects in the immediate vicinity of the Kachina Village Project include the: Fort Valley Forest Restoration Project; Mars Hill Fuels Reduction Project; Arboretum/Naval Observatory Fuels Reduction Project; Airport Fuels Reduction Project; Lake Mary Fuels Reduction Project; Lake Mary Parcels Fuels Reduction Project; Skunk Fuels Reduction Project; and the proposed Kachina Village Forest Health Project are nearly adjacent to each other. All of these projects progress toward a forest condition with less risk of wildfire. The addition of Alternative A for the Kachina Village Project adds a positive cumulative effect.

Cumulative Effects of Alternative B

There are no direct effects to air quality from this alternative and, therefore, no cumulative effects. This alternative has a higher risk of high intensity wildfire that could cumulatively add to other air quality impacts and cause emissions beyond State and National standards.

Cumulative Effects of Alternative C

The cumulative effects of Alternative C are the same as Alternative A with slightly less reduction in fire risk than Alternative A and slightly more reduction in fire risk than Alternative D.

Cumulative Effects of Alternative D

The cumulative effects of Alternative D are similar to Alternative A with slightly less reduction in fire risk than Alternatives A and C.

Cumulative Effects of Alternative E

Alternative E has a considerably lower probability (than the other action alternatives) of preventing a wildfire that would exceed air quality standards. Alternative E has a greater probability of preventing a wildfire than Alternative B. More frequent broadcast burning would be necessary under this alternative, which has a cumulative effect on implementation of other projects. Requiring more “burn days” from ADEQ to complete the Kachina Village Project leaves fewer “burn days” to complete other fuels reduction burning.

Fire

The objectives related to fire effects, as stated in the Proposed Action’s Purpose and Need, Chapter 1, are to:

- Reduce the potential for a large, stand-replacing fire in the wildland-urban interface;
- Increase the resilience of the area to wildfire;
- Protect wildlife habitat;
- Retain and recruit mature ponderosa pine trees and gambel oak; and
- Set conditions for the reintroduction of fire in the ecosystem.

Each of the action alternatives affects the potential for a large stand-replacing fire to varying degrees. The differences of effects in meeting all of the objectives listed above are largest between Alternative E and the other action alternatives.

Affected Environment

Pumphouse Wash, Kelly Canyon, and James Canyon transect the project. These drainages contain fuel and canopy conditions that can generate severe fire behavior. They also provide slope and wind funneling that increase fire behavior. These drainages are left untreated under each of the action alternatives to provide wildlife habitat and travel corridors. The presence of these drainages and their condition amplify the importance of fuels treatments above and in between these drainages.

The fire suppression forces making the initial attack on wildfires that may occur within the project area are wildland fire engines. These initial attack forces can generally take effective suppression action against wildfires with flame lengths of less than 4 feet. Fires with flame lengths greater than 4 feet generally require bulldozers and even air tankers. It might even require an indirect-attack strategy, which requires considerably more distance and time to control the fire.

Flame length is also a reliable indicator of fire intensity and the probability of tree mortality. Hence it can indicate how effectively each action alternative meets the other fire-related objectives identified in the Purpose and Need, Chapter 1.

In the analysis, the Fuel Management Analyst software was used to model wildfire behavior that would probably occur after each of the treatments (PRD 149). Common to each action alternative is a considerable change in treatment across three areas of the proposed project. The first area or zone is within 1 mile of the residential neighborhoods. Within 1 mile of residential, thinning trees up to 9 inches was compared with thinning to an average of 50 basal area left by Alternatives A, C, and D. Alternatives C and D differ from Alternative A only by a 16- and 18-inch diameter restriction, while Alternative E cuts trees 9 inches or less on a large portion of the area within 1 mile of the residential neighborhoods.

The second zone is greater than 1 mile from the neighborhoods yet north of James Canyon. North of James Canyon, thinning to an average basal area of 80 (Alternative E) was compared with thinning to an average basal area of 50 left by Alternatives A, C, and D.

And the third zone is the area south of James Canyon where thinning trees 9 inches or less (Alternative E) was compared with thinning to a 50 basal area (Alternatives A, C, and D).

Direct Effects of Alternative A

Alternative A has the greatest reduction in crown fire potential and severe fire behavior immediately after treatment across all three zones (a fire-related objective). This alternative has the greatest reduction of fire hazard to both the nearby communities and the forest itself. It provides the greatest canopy break (assessed in both percent of opening and distribution of the breaks), the greatest reduction of fire-laddering fuel, and it is the most effective in meeting fire-related objectives.

Within 1 mile of the residential neighborhoods, the flame lengths generated by the model were reduced from 5.7 feet to 3.5 feet and the probability of large tree (12 to 20-inch dbh) mortality was reduced from over 90 percent to less than 20 percent. Farther than 1 mile, yet north of James Canyon, the model indicated this alternative would reduce flame lengths from 7.2 feet to approximately 4 feet and the probability of tree mortality from over 90 percent to less than 16 percent. South of James Canyon the model indicated that this alternative would reduce flame lengths from 7.2 feet to 3.5 feet and tree mortality from over 90 percent to less than 16 percent.

Recreation and road management activities will lessen fire risk in a similar manner for all action alternatives.

There is no effect from riparian rehabilitation activities at Kelly Seep.

Direct Effects of Alternative B

There are no direct effects to fire behavior from the No Action Alternative.

Direct Effects of Alternative C

Alternative C is somewhat less effective in reducing crown fire potential and severe fire behavior across the three zones. The reduction in the fuel load should be as great as Alternative A, although there would be slightly more canopy-closure and a slightly greater number of fire-prone trees.

Direct Effects of Alternative D

Alternative D may be slightly less effective in reducing crown fire potential and severe fire behavior than Alternative A. Under Alternative D, 2,000 fewer trees are thinned than Alternative A. The model is not sensitive enough to discern this small difference between Alternatives A and D. Therefore, the model did not indicate any difference in expected flame length or probability of large tree (12 to 20-inches dbh) mortality between Alternatives A and D.

Alternative D appears to reduce the fire hazard to both the nearby communities and the forest itself as much as Alternative A. Within this project area, it provides only slightly less canopy break and almost as much reduction in fire-laddering fuel as Alternative A.

Direct Effects of Alternative E

Alternative E has the least reduction in crown fire potential and severe fire behavior, but in most instances it showed improvement over the existing condition. Within 1 mile of the residential neighborhoods, the flame lengths generated by the model were not reduced at all (5.7 feet). These flame lengths would make initial attack difficult and ineffective.

This alternative proposes an "intensive zone" treatment for a width of 660 feet where the national forest meets private property. This zone is intended to mitigate the effects of fire resulting from thinning trees only up to 9 inches diameter and having higher canopy closures over the rest of the project area. Initial attack has been quite effective against fires starting in such a fuel break. However, on the Coconino National Forest, a 660-foot-wide fuel break has not proven to be an effective fire stop against fires approaching from beyond such a strip. An illustration is the Slate Fire (1996). An entire strike team of wildland fire engines was unable to even slow down the forward spread of the fire at any of three separate breaks similar to the "intensive zone" treatment.

Jack Cohen's research on wildfire-related structure loss was referenced in comments received in response to the Proposed Action. This research recommended the "intensive zone approach." Cohen's argument that homeowner's could take action to protect their houses is important to those living in the wildland-urban interface. However, Mr. Cohen's research narrowly focuses on "home ignitability" and the combustion of structures. It cannot be extrapolated to address the safety of the adults and children living in a home or working in a community that is threatened by wildfire.

Research showing that an "intensive zone" treatment is effective in protecting structures assumes that emergency response personnel have had enough time to safely remove all the children and adults from harm's way. Consider the time it would take a local law enforcement agency to gather enough personnel to control entrance and exits to a threatened neighborhood. Consider the time and personnel it would take to notify residents and employees door-to-door. Consider the time it would take a parent to gather up each of their children playing out in the woods, over in a friend's backyard, or who have bicycled down to the neighborhood store. Alternative E does not treat enough of the forest to sufficiently reduce the possibility of a severe fire spreading rapidly to nearby communities.

Indirect Effects of Alternative A

By reducing the expected fire intensity more than the other alternatives, Alternative A provides the most resilience to fire (a fire-related objective). The reduction in the fuel load and the increased openness of the canopy will allow prescribed burning under a wider range of weather conditions. This is extremely important because each of the action alternatives requires periodic prescribed burning of the forest floor to maintain the reduction in crown fire potential and severe fire behavior achieved by the initial treatment (a fire-related objective).

Having a wider range of weather conditions in which to burn increases the number of days a prescribed burn can be executed. The wider range also allows a greater variety of fire effects as well as reducing burn costs and smoke impacts.

Alternative A provides a higher degree of habitat protection (a fire-related objective) by reducing the probability of tree mortality more than the other alternatives (induced by both wild and prescribed fires). By reducing the probability of mortality among large trees (12 to 20 inches dbh) more than the other alternatives, this alternative is also most likely to retain and recruit mature ponderosa pine trees (a fire-related objective).

Indirect Effects of Alternative B

Alternative B calls for no action. As stated in the existing condition section, the current fuel and vegetative conditions would likely generate severe

fire behavior. The modeling indicated considerable torching and spot fires more than half a mile ahead of a running crown fire. The forest condition after a high intensity wildfire would likely not meet management direction in the Forest Plan for a variety of resources.

The modeling indicated an extremely high occurrence of tree mortality (78 to 98 percent) among large trees (12 to 20 inches dbh). Modeling also indicated that a fire starting even as far as 2 miles from the residential areas could burn through Kachina Village, cross a 4-lane highway, and threaten other neighborhoods farther north during one burning period.

Indirect Effects of Alternative C

The difference in Alternative C is difficult to model with precision, since relatively few trees larger than 16-inches dbh would be removed under Alternative A. The model did not indicate any difference in expected flame length or probability of large tree (12 to 20-inches dbh) mortality between Alternative A and C. This alternative would allow prescribed burning under a slightly narrower range of weather conditions than Alternative A.

Alternative C is similar to Alternative A, but does not thin trees greater than 16-inches dbh. Those trees greater than 16 inches targeted for removal under Alternative A and retained under this alternative have some canopy characteristic that worsens the expected fire behavior. This alternative could not remove: large trees (greater than 16 inches dbh) with disease or infection that make the tree more prone to torching; trees greater than 16-inches dbh with genetic flaws that propagate fire-prone regeneration; trees greater than 16-inches dbh that bridged a desired break in the canopy; and trees greater than 16-inches dbh with crown ladders and interlocking crowns. Adequate canopy breaks are necessary to reduce crown fire risk

Indirect Effects of Alternative D

With so few trees greater than 18-inches dbh being removed with Alternative D versus Alternative A, the model was unable to show any difference in fire intensity between the two. Therefore, Alternative D should provide as much resilience to fire. This alternative is effective in meeting the other fire-related objectives as well.

Modeling in these stands indicated the same probability of tree mortality as Alternative A (induced by both wild and prescribed fires). Therefore, Alternative D should provide as high a degree of habitat protection as Alternative A (a fire-related objective). With the same probability of mortality among large trees (12 to 20-inches dbh), this alternative is as likely as Alternative A to retain and recruit mature ponderosa pine trees (a fire-related objective) with a few more mature ponderosa pine possibly killed by fire.

Alternative D would allow prescribed burning under a wide range of weather conditions. Each of the action alternatives requires periodic prescribed burning of the forest floor to maintain the reduction in crown fire potential and severe fire behavior achieved by the initial treatment (a fire-related objective). The wider range also allows a greater variety of fire effects as well as reducing burn costs and smoke impacts

Alternative D is similar to Alternative A, but does not thin trees greater than 18-inches dbh. Those trees greater than 18-inches dbh retained would have some canopy characteristics that worsen expected fire behavior. This alternative could not remove: large trees (greater than 18-inches dbh) with disease or infection that make the tree more prone to torching; trees with genetic flaws that propagate fire-prone regeneration; and trees greater than 18-inches dbh with crown ladders and interlocking crowns. This thinning restriction would also interfere with creating adequate canopy breaks in some locations.

The probability that a mistletoe-infected tree (retained because it is greater than 18-inches dbh) could infect other trees within spore-transport distance is a difference from Alternative A, since a mistletoe-infected stand is much more flammable.[13] The other canopy characteristics do not appear to considerably worsen the expected fire behavior because of the small number of trees greater than 18-inches dbh targeted for removal under Alternative A.

Indirect Effects of Alternative E

Alternative E would fail to meet other fire-related objectives within 1 mile of the residential neighborhoods, since flame lengths and fire intensity generated by the model were not reduced from the existing condition due to the high number of sites

[13] Mistletoe creates dense branches sometimes referred to as “witches broom”.

Table 9. Fuels Management Analysis[1]

Location[2]	Site[3]	Treatment	Effective Canopy Base Ht.	Flame Length Generated by Model	Flame Length That Initiates Crownfire	Fire Type Generated By Model	Probability of Mortality 12" dbh (%)	Probability of Mortality 14" dbh (%)	Probability of Mortality 16" dbh (%)	Probability of Mortality 18" dbh (%)	Probability of Mortality 20" dbh (%)
Within 1 Mile of Residential											
335	15	Existing	8	5.7	5.1	Passive Crown	98	96	95	91	78
		9-inch limit	15	5.7	7.9	Surface	98	96	95	91	78
		50 BA	15	3.5	7.9	Surface	17	12	9	7	5
336	5	Existing	9	5.7	5.6	Passive Crown	97	93	86	31	60
		9-inch limit	15	5.7	7.9	Surface	97	93	86	31	60
		50 BA	35	3.5	14.2	Surface	16	12	9	7	5
North of James Canyon											
344	4	Existing	16	7.2	8.3	Surface	98	96	95	94	92
		80 BA	24	4.1	10.9	Surface	16	12	9	7	5
		50 BA	24	4.4	10.9	Surface	16	12	9	7	5
344	10	Existing	14	7.2	7.5	Surface	98	96	95	94	92
		80 BA	22	4.1	10.3	Surface	21	12	9	7	5
		50 BA	24	3.5	10.9	Surface	16	12	9	7	5
344	19	Existing	18	4.4	9.0	Surface	28	14	10	7	5
		80 BA	27	3.5	11.9	Surface	16	12	9	7	5
		50 BA	30	2.5	12.8	Surface	16	12	9	7	5
South of James Canyon											
354	8	Existing	13	7.2	7.2	Passive Crown	98	96	95	90	84
		9-inch limit	20	7.2	9.6	Surface	98	96	95	90	84
		50 BA	30	3.5	12.8	Surface	16	12	9	7	5
354	10	Existing	8	7.2	5.1	Active Crown	98	96	95	90	84
		9-inch limit	13	7.2	7.2	Pass Crown	98	96	95	90	84
		50 BA	12	3.5	6.8	Surface	16	12	9	7	5

[1] The Fuels Management Analysis for the Kachina Village Forest Health Project was conducted using the Fuels Management Analyst Program (PRD 149).

[2] The location, previously called compartment, is a grouping of stands.

[3] A site is a stand of trees.

with a 9-inch diameter limit. The probability of large tree (12 to 20 inches dbh) mortality would remain very high at over 90 percent. However, the flame length would be increased to 7.9 feet by this alternative (within this northern zone) which would increase the likelihood of a wildfire moving into the tree crowns. Prescribed burning weather conditions would have a considerably narrower range than the other action alternatives provide.

Farther than 1 mile, yet north of James Canyon, the model indicated Alternative E would reduce flame lengths from 7.2 feet to approximately 4 feet and the probability of tree mortality from 90(+) percent to 16(-) percent for a wildfire originating in this zone. Within this zone, the model indicated the only considerable difference in tree mortality between the action alternatives was among trees less than 12-inches dbh. Alternative E leaves a higher degree of closed canopy (in this middle zone) that could increase tree group torching and spotting.

Only within this middle zone does Alternative E come close to Alternative A in meeting each of the fire-related objectives. Within this middle zone, the reduction in the fuel load and the increased openness of the canopy would allow prescribed burning under as wide a range of weather conditions as Alternative A and probably a wider range than Alternatives C or D.

South of James Canyon, the model indicated that Alternative E would not reduce flame lengths from 7.2 feet nor would it decrease tree mortality from over 90 percent. The model indicated that a fire occurring in this zone after Alternative E was applied would almost certainly produce multiple spot fires in Kelly and James Canyons. Fires in these canyons would, in turn, generate severe fire behavior, spotting over long distances, and threatening several communities to the north. Within this southernmost zone, the probability of tree mortality would remain over 90 percent in all size classes. Prescribed burning weather conditions would have a considerably narrower range within this zone than the other action alternatives. Therefore, Alternative E would fail to meet several of the fire-related objectives within this southern zone.

Cumulative Effects of Alternative A

Wildfires in the wildland-urban interface place particularly high demands on emergency response personnel. Such a fire threatens multiple structures and multiple groups of people in a very short span of time. Firefighting resources must be deployed to protect the people and properties that lie in the fire's path, as well as to extinguish the fire. This complex situation not only leaves fewer firefighters to suppress the wildfire, but also fewer firefighters to respond to unrelated medical emergencies and structure fires that normally occur within urban settings.

Fuel reduction treatments within the wildland-urban interface should reduce expected fire behavior to a level at which a small number of response personnel can quickly and effectively control a wildfire.

Accumulating fuel treatments over a greater area is beneficial, reducing the possibility that a wildfire can get established, and reducing the intensity with which a wildfire can burn. Each of these fuel treatments in the Flagstaff area has the cumulative effect of reducing the total number of acres through which a fire can spread virulently. The cumulative effect of this alternative further reduces the probability that the demand on emergency response personnel will be exceeded.

The following list shows projects from the recent past, and present that occur within the Flagstaff wildland-urban interface[14] and in the vicinity of the Kachina Village Project. It includes those listed in the introduction of this chapter, as well as additional projects around Flagstaff and its communities. Other projects, not described in detail here, have occurred farther in the past and contributed to current forest conditions. All acres are approximate.

- Fort Valley Restoration Project (5,000 acres)
- A-1 Ecosystem Management Project (2,500 acres)
- Mars Hill Fuels Reduction Project (500 acres)
- Arboretum/Naval Observatory Fuels Reduction Project (600 acres)
- Airport Fuels Reduction Project (1,000 acres)
- Lake Mary Fuels Reduction Project (1,800 acres)
- Skunk Fuels Reduction Project (500 acres)

[14] The Fire Management Analysis Zone 1U was used to identify these projects in the wildland-urban interface.

- Pumphouse Multiproduct Timber Sale (750 acres)
- Elden Fuels Reduction Project (100 acres)
- Townsend Winona Fuels Reduction Project (300 acres)

One formal proposed action exists for a future fuels reduction project at this time. The Oak Creek Canyon Fuels Reduction Project is a proposal to develop a comprehensive fire management plan to reduce fuels in Oak Creek Canyon. Acres are unknown at this time.

On State Section 26 (1/2 of the section) a pulpwood sale of less than 12-inch diameter trees occurred 5 years ago. Currently slash piles exist on this section. Future planned activities on Section 26 are to re-pile and burn the existing slash piles, conduct pre-commercial thinning, continue to allow livestock grazing, and finish filling in a rock pit. Trees are marked for pre-commercial thinning; however, there are currently no funds to carryout the thinning and pile burning on Section 26 (Paijkos personal communication, 2001).

The above listed projects tend to link fuel treatments that are nearly adjacent to each other. Each of these fuel treatments in the Flagstaff area has the cumulative effect of reducing the total number of acres through which a fire can spread virulently. The Kachina Village Project adds to these effects and further reduces the probability that the demand on emergency response personnel will be exceeded. The reduction in risk of high intensity wildfire cumulatively reduces the deleterious effects of such a fire on the landscape.

Cumulative Effects of Alternative B

The absence of an effective fuel treatment under this alternative would prevent it from accumulating the benefits of reduced fire hazard in conjunction with other fuel treatment projects. The No Action Alternative actually reduces the benefits of other nearby fuels treatment projects by leaving a high fire hazard area, analogous to a hole in the layer of protection around Flagstaff.

Cumulative Effects of Alternative C

The cumulative effects of Alternative C are similar to Alternative A except there is a slightly smaller reduction in the risk of high intensity crown fire as a result of trees retained in this alternative that would have been removed under Alternative A (7,000 trees).

Cumulative Effects of Alternative D

The cumulative effects of Alternative D are similar to Alternative A.

Cumulative Effects of Alternative E

For the reasons stated in the narrative above, Alternative E does not sufficiently reduce the possibility of a severe fire spreading rapidly to nearby communities. The fuel treatments proposed for the northern and southern zones under Alternative E would not accumulate as much fire hazard reduction in conjunction with other fuel treatment projects. This alternative actually reduces the benefits of other nearby fuels treatment projects by leaving a high fire hazard area in the layer of protection around Flagstaff.

Vegetation

Affected Environment

The vegetation on the Kachina Village Forest Health Project is comprised mostly of younger ponderosa pine (blackjacks) of various densities, associated with Arizona fescue (*Festuca arizonica*) and mountain muhly (*Muhlenbergia montana*) in the understory. Existing older ponderosa pine (yellow pine) are scattered throughout as individuals and small groups but are not numerous in most places. There is quite a bit of Gambel oak in the southern part of the project and the steeper slopes of James and Kelly Canyons have a good component of Douglas-fir, especially on the north-facing slopes. Riparian species and conditions exist in the bottom of the canyons. Because of the moderate to heavy canopy cover and density of much of the project area, grasses/forbs and understory shrubs are not in good condition. The underlying parent material is limestone in the northern part of the project area and basalt with areas of sandstone in the rest of the area.

Most of the area, even portions of the steeper canyons, was heavily logged in the railroad-logging era of the late 1800's to the early 1900's. It was not unusual to take every usable tree for railroad ties and mining props, as well as lumber—maybe leaving a few blackjacks as seed trees. The mature yellow pine we have today are very likely those leave trees that were left 80 to 100 years ago. These conditions, in conjunction with heavy grazing from sheep and cattle in the early 1900's, and an unusually heavy ponderosa pine cone crop and optimum moisture

patterns in 1919, resulted in very heavy pine regeneration. The increased density in the 70 to 80-year blackjack pine (approximately 7 to 14 inches in diameter—or poles and mid-aged trees) that we have today is a direct result of that heavy regeneration.

The present age class distribution and density (acres and percent of the total area) of ponderosa pine in the Kachina Village Project area are displayed in Table 10.

There are also 42 acres (0.5 percent of the area) of grass/shrubs and 2,703 acres of private and State Trust Land within the project area. The above data show that 86 percent of the trees (primarily ponderosa pine) are between 5 to 18-inches dbh (poles and mid-aged). Approximately 93 percent of the project area is moderate to heavy in density. These classifications and acres were derived from stands where each stand was inventoried and assigned an age class and density description (Vegetation Structural Stage or VSS). It should be noted that most stands have more than one age class category—the most common occurrence being primarily pole or mid-aged stands in denser groups with less groups or smaller groups and individuals of mature or old-growth included. Also, the arrangement among trees tends to be random or grouped, not homogeneous. The classification for the stand represents the most common age group within that stand.

Much of the project area has small groups of Gambel oak scattered throughout, usually of smaller diameter stems up to about 10-inches dbh. Some of these groups are growing in small openings of their own and growing fine, but many are being crowded and overtopped by larger ponderosa pine which tends to suppress their growth.

Dwarf mistletoe occurs on ponderosa pine throughout the area in patches. While it can be severe in individual patches and cause or contribute to tree mortality, it does not seem to be a serious problem over the entire area. Tree mortality caused by bark beetles due to physiological stress from very dense conditions and competition among trees will continue. Currently, this mortality occurs in individual trees or small pockets scattered throughout the denser stands. To date, mortality caused by bark beetles has not caused serious problems, but it has slightly increased from year to year since we first noticed it about 10 years ago. This mortality adds to the existing fuel loading of the stand and may create small openings within the stand if enough trees are killed. In addition, current dense stand conditions contain the potential for larger scale mortality from bark beetles.

Forest Vegetation Simulator (FVS) is the computer model used to project various stand parameters into the future for a given alternative. The original data came from compartment exam data and reflect stand averages. The modeled treatment is somewhat different than what will actually occur on the ground. Stands chosen for on-the-ground treatment are generally overtopped and smaller. Trees are grouped by cutting small corridors or openings between groups, while the larger trees are retained. Smaller diameter trees are retained if they are growing vigorously with good growth characteristics. A larger diameter tree may be cut in place of a smaller one if the larger tree has some flawed growth characteristic, dwarf-mistletoe infection, or has been attacked by bark beetles. Enough trees are cut to leave a desired density to meet certain objectives such

Table 10. The Present Age Class Distribution and Density, by Number of Acres and Percent of Project Area, for Ponderosa Pine (*Pinus ponderosa*).

Age Class	Number of Acres	Percent of Project Area
Seedlings/Saplings	385	5
Poles	4,761	62
Mid-aged	1,867	24
Mature	449	6
Old-growth	210	3
Total	7,672	100
Density		
Open canopy 0-39% (Canopy A)	498	6
Medium canopy 40-59% (Canopy B)	3,302	43
Dense canopy 60%+ (Canopy C)	3,872	50
Total	7,672	100

as the promotion of better growth and vigor among residual trees, reduction of the impact of dwarf-mistletoe, promotion of grass/forb development in the understory, or reduction of the risk of crown fires. These densities can, and often do, vary throughout a stand. This is complex and fairly difficult to model. This particular model is spatially independent, which means that it cannot model the complexities of groups, small openings, or variable spacing between trees. FVS assumes that the trees are spaced homogenously throughout the stand. It is also difficult to model different density objectives within a stand. However, the model can be useful in comparing alternatives and projecting future conditions as long as we remember these limitations and look at trends rather than the veracity of a particular number. The growth rates for given densities are realistic. Table 11 displays certain stand parameters taken from seven selected stands through time. These growth simulations are based on the assumption that stands are treated initially under each alternative. However, no further treatments are conducted because this analysis is measuring the effects of only this entry. Table 11 displays growth for seven selected stands as modeled by the FVS.

Table 11. Growth for Seven Selected Stands. (Growth was modeled by Forest Vegetation Simulator (FVS) for a period of 49 years based on five alternative treatment regimes.)

Year Per Alternative	Trees Per Acre	Basal Area (ft^2)	QMD (inches)	TPA 24+ inches
2000				
Alt. B	228	149	7.2	0.9
Alt. A	115	83	12.7	0.9
Alt. C	114	86	12.8	0.9
Alt. D	115	84	12.7	0.9
Alt. E	143	111	12.7	0.9
2019				
Alt. B	221	176	8.3	1.4
Alt. A	110	107	14.4	2.1
Alt. C	109	110	14.3	2.1
Alt. D	110	108	14.4	2.1
Alt. E	136	135	14.0	1.8
2049				
Alt. B	210	210	9.6	2.7
Alt. A	103	136	16.9	6.6
Alt. C	102	139	16.7	6.8
Alt. D	103	137	16.8	6.7
Alt. E	128	166	16.1	4.4

Our experience from observations at Taylor Woods shows that we can maintain a healthy grass/forb component within a forest stand measuring up to about 60 square feet of basal area. Grasses and forbs decline considerablely underneath the tree canopy from 60 to 80 sq. ft. of basal area, and are barely present in the understory with basal areas above 80 sq. ft. For the Kachina Village Forest Health Project, this means we have a healthy grass/forb component on only about 6 to 7 percent of the entire area as an average. Since we are using stand averages, there may be slightly more than this amount in small openings overall, but not a great deal. This is in stark contrast to historical reference conditions where approximately 85 to 90 percent of the area had a thriving grass/forb community present. Since there are approximately 140 or so species of grasses, forbs, sedges, and shrubs from research conducted by NAU on their Centennial Forest (personal conversation Margaret Moore, NAU) compared to only 3 or 4 tree species, the amount of grass understory has some serious implications for both the amount and composition of native biodiversity.

Even with broadcast burning occurring, some pine seedlings may establish over time. However, the overall percentage of VSS 2 (seedlings and saplings) is not expected to change over time. In order to accurately display the differences between alternatives for the larger diameter material, predicted regeneration after treatment was not considered. This allowed the model to focus on the differences between alternatives of the larger size trees.

Direct Effects of Alternative A

The treatments of Alternative A will shift the average age/diameter class from young-aged forest, 9 to 11.9-inches dbh (62 percent of the analysis area) to mid-aged forest, 12 to 17.9-inches dbh (57 percent of the area). The computer model shows the average diameter to increase from 7.2 inches in Alternative B (No Action) to 12.7 inches in Alternative A, directly after cut (see Table 11). This is entirely due to mathematical averages as smaller trees are removed and larger trees remain. The treatments will also

reduce overall density from 50 percent of the area in "C" canopy closure to 16 percent of the area in "C" canopy closure. Correspondingly, the "A" canopy closure will increase in acres from 6 percent before the treatment to 32 percent after the thinning.

Reducing the overall density in Alternative A (Proposed Action) has the most effects. This alternative will reduce competition among all tree species, allowing increased growth rates for oak as well as pine and, therefore, more vigorous conditions. Oak tends to be suppressed by pine, so the oak will immediately respond beneficially from removal of pines that overtop them. More vigorous conditions allow individual pine trees to better withstand bark beetle attacks. The more open stands reduce the trees physiological stress. Finally, focusing the thinning on the smaller trees (thinning from below) will dramatically reduce the fuel laddering conditions that contribute to destructive crown fires. The amount of thinning and creation/enhancement of forest openings will break up the heavy canopy closure, and improve understory, also reducing fire risk conditions.

More open conditions allow for more grasses, forbs, and shrubs to grow which can increase the number and amount of biodiversity and be beneficial to many wildlife species. The rehabilitation actions at Kelly Seep also contribute to biodiversity.

There are no direct effects to vegetation from recreation and road management activities as proposed. Short-term effects to ground cover from broadcast burning are described in the soil and water section below.

Direct Effects of Alternative B

There are no direct effects from Alternative B (No Action).

Direct Effects of Alternatives C and D

These two alternatives are the same as Alternative A (we will still treat the same 4,804 acres) except that we will not cut any trees that are 16-inches dbh or greater in Alternative C and 18-inches dbh or greater in Alternative D.

Under Alternative C, approximately 7,000 fewer trees will be cut, compared to Alternative A (Proposed Action). This restriction will change the VSS class of only three stands, resulting in no difference in VSS classes and very slight differences (1 percent) in crown canopy closures (density). On these three stands there were enough larger trees cut that Alternative C would change the density from an A canopy (less than 40 percent crown canopy closure) to a B canopy (40 to 60 percent crown canopy closure). The amount of difference between Alternative A and Alternative C is small. Also, the VSS categories have a wide range of inclusion. Small differences often do not show up in the VSS categories unless they occur right at the breaking points between categories. Under Alternative D, approximately 2,000 fewer trees will be cut than Alternative A.

One of the project objectives is to manage for 10 percent of the area in small openings. To accomplish this, there is a need to enlarge some existing small openings. The intent is to remove smaller diameter trees whenever possible, but it may be necessary to cut an occasional larger tree and limiting trees cut to less than 16 inches or 18 inches may hinder this effort. This is especially evident for Alternative C where the estimated percent of openings drops from 10 percent in Alternative A to 5 percent in Alternative C.

Also, both bark beetles and dwarf mistletoe are present in the project area and have caused mortality in larger sized ponderosa pine individually and in small groups. There is more flexibility to treat the occasional outbreak of bark beetle or mistletoe if trees 16 or 18 inches or over can be removed as needed for this purpose. Under Alternatives C and D there is less flexibility to accomplish bark beetle and mistletoe treatment.

Direct Effects of Alternative E

Treatments in Alternative E will result in average diameters greater than Alternative B, but not as much as Alternative A over 50 years (9.6-inches dbh for Alternative B; 16.1-inches dbh for Alternative E; and 16.9-inches dbh for Alternative A). The computer model shows the average diameter to increase from 7.2 inches in Alternative B to 12.7 inches in Alternative E (as well as Alternative A) immediately after treatment. This is entirely due to mathematical averages as smaller trees are removed and larger trees are retained. The alternative treatments will immediately shift the average age/diameter class from young forest, 5 to 11.9-inches dbh (62 percent of the existing structure) to mid-aged forest, 12 to 17.9-inches dbh (44 percent of the area after treatment). Likewise, treatments will reduce density from 50 percent (Alternative B) to 31 percent in Alternative E for the "C" canopy closure, but not as much as the 16 percent for Alternative A. Because

the cuts in Alternative E are not as heavy as the cuts in Alternative A, the effects lie between Alternative B and Alternative A, and the resulting benefits of increased tree growth and vigor are about half of Alternative A.

Alternative E accomplishes only about half of the oak release that would occur in Alternatives A, C and D. Grass/forb establishment will be helped about twofold (the "A" crown canopy closure increases from 6 percent to 12 percent), but not as much as for Alternative A (the "A" crown canopy closure increases from 6 percent to 32 percent, or fivefold). Therefore, native biodiversity in the grasses/forbs and shrubs will benefit about twice as much as Alternative B but not quite half as much as with Alternative A. Limiting tree removal to 9 inches and less on certain stands will hinder the creation of 10 percent of the area in openings.

Indirect Effects of Alternative A

The computer model suggests that Alternative A will achieve twice the growth at half the mortality over Alternative B (No Action) over time. Also, we will have over twice the number of large-sized trees (24+/- inches dbh) after 50 years than Alternative B. The reduction of competition and stress and promotion of vigorous growing conditions within the stands greatly reduces the risk of serious bark beetle mortality.

Alternative A would reduce the pole-size age class by more than 35 percent and the dense canopy closure by more than 34 percent. Therefore, stand susceptibility would be reduced compared with Alternative B (No Action).

Pine regeneration will result from the created openings and broadcast burns, but plans to conduct broadcast burns over time will kill most of the pine seedlings, maintaining a primarily 2-aged older stand structure.

Indirect Effects of Alternative B

Pine trees will continue to grow at slow rates, averaging about 0.3 to 0.4-inches diameter growth per decade.

Current stand structures are characterized by a high degree of fuel laddering, with smaller, overtopped trees and a large amount of closed and continuous canopy closure (over 93 percent of the project area has either very dense or moderately dense canopy closure). This will continue and even increase over time, contributing to undesirable fire risk conditions.

The indirect effects of having so much of an area in high density stand conditions has some major implications from a forest health aspect due to potential mortality from bark beetles. Several species of bark beetles affect ponderosa pine on the Coconino National Forest, with the most important being the western pine beetle and pine engraver beetles (*Ips* spp.). These agents are among the most important mortality agents affecting ponderosa pine. Outbreaks of the western pine beetle are mostly associated with relatively dense, mature pine forests and are often precipitated by drought. Pine engraver beetles prefer to breed in fresh pine debris, but under certain conditions will attack living trees, typically smaller diameter trees or tops of larger trees. The western pine beetle targets dense stands also. Historically, frequent fire regimes in the ponderosa pine forests may have limited bark beetle populations by maintaining stands in an open condition. In the absence of fire or other stand disturbance, susceptibility to bark beetles will increase over time, especially if drought conditions continue.

Analysis of existing conditions (Alternative B) consisted of using current stand variables to develop hazard ratings of bark beetles attacking ponderosa pine. The hazard rating system was previously adapted by Jill L. Wilson, former entomologist with the Arizona Zone Entomology and Pathology Office, from the rating system developed by Munsen and Anhold (Chojnacky et al., 2000). The rating method requires stand measurements of basal area, average ponderosa pine diameter at breast height (dbh), and the proportion of ponderosa pine in the canopy. Although this hazard rating system was originally developed for mountain pine beetle, it has been transferred to other Dendroctonus bark beetles attacking ponderosa pine.

Based on the current stand data, all compartments have composite stand values in the moderate to high hazard categories. Of the 43 stands analyzed, 30 are in the high hazard category, 13 in the moderate category, and none in the low category. Furthermore, all compartments had at least 50 percent of stands in the high category. Therefore, it can be concluded that much of the analysis area is moderately to highly susceptible to bark beetle attack. (See Table 12.)

The amount of tree mortality varies considerably during bark beetle infestations. Sometimes only a few groups of trees are attacked and killed, but in other situations literally thousands of pine trees can be killed. Within severely impacted areas, *Ips* populations in central Arizona have killed up to 176 trees per acre and nearly all tree size classes were affected (Parker, 1991). Roundheaded pine beetle outbreaks in New Mexico and Arizona have resulted in basal area reductions ranging from 25 to more than 50 percent (Negrón et al., 2000). Mortality caused by the western pine beetle typically has been limited to small pockets of ponderosa pine within the recent history of Arizona, but has the potential to cause extensive mortality (DeMars and Roettgering, 1982).

Factors that influence the amount of mortality are not well understood, but factors contributing to more severe outbreaks include extensive stands of susceptible hosts, extended periods of drought or other favorable climatic conditions, and consecutive years of creating slash within adjacent areas.

Indirect Effects of Alternatives C and D

Differences between Alternatives C and D and Alternative A are not measurable in terms of improved growth, number of trees 24 inches in diameter or greater, and a reduced mortality over time. Long-term effects on the reduction of susceptibility to bark beetle infestation are the same for Alternatives C and D as for Alternative A.

Indirect Effects of Alternative E

Growth rates and individual tree vigor is greater than Alternative B, but only about half as much as Alternative A. In regards to bark beetle susceptibility, there are slight differences between the effects of Alternative E and Alternatives A, C, and D. More acreage would be retained in the pole-size age class and there would be less acreage in the mid-aged to mature age classes in Alternative E compared with the other action alternatives. Crown canopy density distribution under Alternative E retains 85 percent of the area in B and C canopy densities, where Alternatives A and D maintain 60 percent and Alternative C, 61 percent. There would be a considerable reduction in both the pole-size age class and the dense canopy compared with Alternative B. Therefore, Alternative E also would reduce stand susceptibility to bark beetle attack compared with Alternative B.

Cumulative Effects of Alternative A

The projects discussed here are immediately adjacent to the Kachina Village Project area. This is because a tree removed from one location only affects the trees immediately surrounding it. The effects of reducing tree densities and, thereby, increasing tree vigor are additive to the lessening of the possiblility of large scale mortality from fire, insects or disease across the larger landscape. This effect occurs in areas surrounding the project area, unlike fire effects which look at the wildland-urban interface.

Many past projects and management activities have shaped the current conditions as described in the affected environment part of this section. The majority of acreage in the Kachina project and adjacent areas (Swinging Timber Sale around Mountainaire, Newman Timber Sale directly to the east of the Kachina Project area, and the Woody area to the west) support high densities of ponderosa pine, usually in excess of 120 basal area. The Swinging and Newman Sales were treated about 10 to 12 years ago with a relatively light cut. While

Table 12. Composite Stand Hazard Rating Value.

Location (Compartment Number)	Ponderosa Pine Percent	Average DBH (inches)	Stand Basal Area (ft^2/ac)	Composite Stand Values	Hazard Rating
335	3	2.5	3	8.5	High
336	3	2.25	2.25	7.5	Moderate
344	3	2	2.55	7.55	Moderate
345	3	2	2.8	7.8	Moderate
354	3	2.17	2.33	7.5	Moderate
368	3	2.4	2.6	8.0	High
Total	3	2.22	2.59	7.8	Moderate

helping reduce overall density somewhat, there are still extensive areas of high density pine stands present. The Woody area to the west has not been treated for at least 20 years.

Recent past projects adjacent to the Kachina Village Project area are the Pumphouse Multiproduct Timber Sale and tree removal within the easement fences of Highway 89A. The northern part of the project area was recently logged in the Pumphouse Timber Sale in 1998/99. This sale harvested selected trees 5-inches dbh and greater, and was a relatively light cut, thinning from below. Some of the units had precommercial thinning (cutting selected trees between 1 and 5-inches dbh) associated with them. A total (both pre-commercial and commercial thinning) of 1,359 acres were treated under the Pumphouse Timber Sale.

The Kachina Village Project adds to the above mentioned projects to lessen the possibility of landscape scale mortality from insects and disease. The effect of reduced crown closures and subsequent increase in herbaceous vegetation is additive to the same effect in the above mentioned projects. This increase is fairly slight for all areas. The faster increase in diameter growth over time due to thinning will add to a similar effect in the above mentioned projects, and offset the lack of large trees in untreated areas.

Cumulative Effects of Alternative B

The potential for bark beetle outbreaks is additive to the same potential in dense stands that occur within portions of the surrounding landscape.

Cumulative Effects of Alternatives C and D

Cumulative effects are similar to Alternative A.

Cumulative Effects of Alternative E

Alternative E will help in reducing bark beetle susceptibility over a larger area, but not as much as Alternative A (Proposed Action). The stand densities and canopy closures will grow back more quickly than other action alternatives and, in conjunction with adjoining areas, will still present a relatively dense pine structure and closed canopy conditions across a large area if no other actions are taken. Few openings will be created, so there is little increase in herbaceous vegetation.

Soil and Water Quality

Affected Environment

The Kachina Fuels Reduction Project is located in the Oak Creek 5th code watershed acres. The project area is also located in two 6th code watersheds: Fry Canyon (618 project acres) and Pumphouse Wash (7,097 project acres). Major drainages within the area include Fry Canyon, Pumphouse Wash, James Canyon, and Kelly Canyon. All of these drainages are ancillary to Oak Creek. Elevations range from approximately 6,800 feet in the northern portion of the project area to approximately 6,300 feet in the far western portion of the project area.

The majority of runoff occurs during the fall and winter months (October to April). Snowmelt from late February to mid-May produces most of the runoff. Occasional winter frontal storms also produce runoff from heavy or prolonged rain events. Very little runoff occurs during the months of mid-May to October.

Fourteen terrestrial ecosystem survey map units exist within the project area. Each unit describes an area with similar slope, vegetation, climate, and physical soil properties. The survey contains predictions and limitations of soil and vegetation behavior for selected land uses. It also highlights hazards or capabilities inherent in the soil and the impact of selected uses on the environment. For example, erosion hazard is predicted based on relative susceptibility of the soil to erosion when vegetation and litter are removed. A slight rating indicates that all vegetative ground cover (vegetation basal area and litter) could be removed from the site and resulting soil loss will not exceed tolerance soil loss rates. A moderate rating indicates that predicted rates of soil loss would result in a reduction of site productivity if left unchecked. Reasonable mitigation measures can be applied to reduce or eliminate soil loss. A severe rating indicates that predicted rates of soil loss have a high probability of reducing site productivity (USDA Forest Service 1992). Following is a brief description of the map units located within the project.

- Map Unit 53: Landform - Valley Plains (63 acres). This component is unsuited for timber production but is well suited to forage production. Soil condition is impaired, resulting from historic livestock grazing and current elk grazing.

- Map Unit 55: Landform - Valley Plains (16 acres). This component is unsuited for timber production but is well suited to forage production. Soil condition is unsatisfactory, resulting from historic livestock grazing and current elk grazing.
- Map Unit 60: Landform - Valley Plains (59 acres). This component occurs in the lower portion of Fry Canyon and is the riparian flood plain.
- Map Unit 471: Landform - Sandstone/ Limestone Escarpments (65 acres). Steep slopes and surface rock fragments limit most management activities. Soil condition is inherently unstable and erosion hazard is severe.
- Map Unit 536: Landform - Elevated Plain (198 acres). This component has a moderate erosion hazard. Maintenance of vegetative ground cover is essential to prevent sheet and rill erosion. Natural regeneration and re-vegetation potentials are high.
- Map Unit 546: Landform - Elevated Plain (1,290 acres). This component has a slight erosion hazard. Natural regeneration and re-vegetation potentials are high. Potential productivity is higher than expected due to higher than normal precipitation.
- Map Unit 550: Landform - Elevated Plain (241 acres). This component has a moderate erosion hazard. Maintenance of vegetative ground cover is essential to prevent sheet and rill erosion.
- Map Unit 555: Landform - Escarpments (1,261 acres). Due to its northern aspect and cooler, moister conditions, this component supports a mixed conifer climax community. This component has a moderate erosion hazard. Maintenance of vegetative ground cover is essential to prevent sheet and rill erosion.
- Map Unit 570: Landform - Elevated Plain (816 acres). This component has a slight erosion hazard and is well suited to timber productivity.
- Map Unit 575: Landform - Escarpment (7 acres). This component has a severe erosion hazard. Maintenance of vegetative ground cover is essential to prevent sheet and rill erosion.
- Map Unit 578: Landform - Elevated Plain (196 acres). This component has a slight erosion hazard. Upon removal of overstory, juniper and oak may offer considerable plant competition.
- Map Unit 582: Landform - Elevated Plain (2,887 acres). This component has a slight erosion hazard. Natural regeneration and re-vegetation potentials are high.
- Map Unit 584: Landform - Hills-Scarp Slopes of Plains (683 acres). This component has a moderate to severe erosion hazard depending on slope. Maintenance of vegetative ground cover is essential to prevent sheet and rill erosion.
- Map Unit 585: Landform - Elevated Plains (353 acres). Shallow soils and surface rock fragments limit most management activities.

Forest roads affect site productivity in the roadbed and log landing area by removing and displacing topsoil, altering soil properties (compaction), changing microclimate, and accelerating erosion. Forest roads take land out of production by removing trees and displacing soil or removing soil during building and maintaining. Currently, approximately 36 miles of classified forest road and 37 miles of private road exist within the project area. At an average width of 20 feet, the road network covers an estimated 177 acres, or 1.7 percent of the 10,417-acre project area. Unproductive national forest land due to roads is 87 acres, or 1.1 percent of forest land within the area. Most of these roads will require some degree of maintenance for project activities. This total is low enough as to not affect overall watershed health. Site-specific instances of erosion occur in some places of the road system.

Compacted forest road surfaces tend to intercept precipitation from rainfall and runoff from adjacent areas, concentrating flow and essentially increasing drainage efficiency and runoff quantity. Depending on the landscape position of forest roads, surface erosion from road surfaces and ditches may have the effect of introducing above background sediment input to streams. Roads adjacent to, or frequently crossing stream channels, have a higher likelihood of introducing sediment to stream channels than those located on ridgetops or mid-slopes. At least in the Northwest, it is believed that most of the sediment from timber harvest activities is related to roads and road building. With the exception of the canyons, the Kachina Village Forest Health Project

area is relatively flat and not prone to mass soil failure, as is documented in the Northwest. The basalt soils in the project area are fairly resistant to erosion and produce little sediment from the road system, even though many of the roads are poorly maintained. There are very few road crossings of perennial streams in the Kachina Village Project and few crossings of ephemeral streams.

The Kachina Village Forest Health Project area occurs within the Oak Creek 5th code watershed. This watershed is ultimately tributary to the Verde River. The watershed is further broken down into the Fry Canyon and Pumphouse 6th code watersheds. Table 13 is a summary of the number of total acres within the Oak Creek 5th code and Fry and Pumphouse 6th code and the percent of the analysis area within the watersheds.

Table 13. Total Acres within the Oak Creek 5th Code, Fry and Pumphouse 6th Code, and the Percent of the Analysis Area within the watersheds.

Watershed (acres)	Kachina (acres)	Percent of Analysis Area Within Watershed
Oak Creek 5th Code Watershed, 298,097 acres	10,416	3.5
Fry Canyon 6th Code Watershed, 19,453 acres	617	3.2
Pumphouse 6th code Watershed, 31,641 acres	9,799	31

Table 14. Summary of the Water Quality Status of Stream Courses Affected by the Kachina Village Project Area.

Waterbody Name Location Reach or Lake Number	Designated Uses	Use Support	Assessment Comments
Oak Creek 15060202-020	A&Wc, FC, FBC, Agl, Agl[1]	Full	Turbidity based on 2 samples in 1993

[1] ADEQ = Arizona Department of Environmental Quality, AGFD = Arizona Game and Fish Department, A&Wc = Aquatic and Wildlife (cold water fish), A&Ww = Aquatic and Wildlife (warm water fish), FBC = Full Body Contact, FC = Fish Consumption, Agl = Agriculture Irrigation, AgL = Agriculture Livestock Watering, DWC = Domestic Water Source.

The Department of Environmental Quality water quality assessment report referred to as the "1998 305(b) Report" is a description of the status of water quality in Arizona. The report was prepared to fulfill triennial reporting requirements contained in the Clean Water Act. Table 14 is a summary of the water quality status of stream courses affected by this project area from this report.

Explanation of Best Management Practices and Guidance Practices

The Non-point Source Intergovernmental Agreement signed by the Forest Service (Region 3) and the Arizona Department of Environmental Quality states that the Forest Service will endeavor to minimize and mitigate all potential non-point source pollution activities. As agreed upon by the State of Arizona and the Forest Service, the most practical and effective means of controlling potential non-point pollutants from forests and rangelands is through the development of preventative or mitigating land management practices, generally referred to as Best Management Practices (BMP's), or in the case of Arizona's process, Guidance Practices (GP's). The purpose of this agreement is to meet objectives defined by the United States Congress in the Federal Water Pollution Control Act (as amended in 1987). These objectives are to restore and maintain the chemical, physical, and biological integrity of Arizona's waters by complying with water quality standards identified for designated uses in downstream perennial waters.

BMP's or GP's were developed for the project area and will apply to all treatment alternatives. These BMP's/GP's are designed to protect soil and water quality (PRD 137c).

Direct Effects of Alternative A

In Alternative A, 19 thinning acres (0.4 percent) occur on soils with severe erosion hazard, 883 thinning acres (18 percent) occur on soils with moderate erosion hazard, and 3,900 acres (81 percent) occur on soils with slight erosion hazard.

The most important direct effect on soil condition will be from mechanical activities (machine piling, feller-buncher, skidder). Ground cover will be disturbed through mechanical actions. Some

compaction from skidding equipment will occur in all treatment areas where machines are used (roughly 4,721 mechanical treatment acres). No skidding compaction or ground cover disturbance will occur where hand thinning is done (roughly 81 hand treatment acres). Skid trails will tend to cause compaction and, in some cases, the channeling of water. The expected duration of effects is less than 10 years. This is estimated to occur in less than 10 percent of the areas that are mechanically treated. Some onsite soil loss will occur on soils with moderate erosion hazard where machines are used (799 acres). Soil loss effects on moderately erosive soils are small in relation to the surrounding landscape and do not contribute to negative soil and water effects overall. Undesirable effects from the proposed activities can be mitigated through the implementation of BMP's. Recommended BMP's are described in PRD 137c. There will be only minor impacts to onsite soil quality and productivity.

Alternative A proposes to manage dispersed recreation along FR 237. Currently, there are substantial areas of bare, compacted soil due to unmanaged camping sites and the social roads associated with the sites. Designating sites for camping will help limit soil disturbance and protect the riparian area in Pumphouse Wash. Some of the compacted areas will be rehabilitated by scarification and seeding. The proposed management changes in the Mexican Pocket area will allow for rehabilitation of roads and camping sites in the mountain meadow adjacent to Highway 89A. Trail management proposals should provide for better maintenance and definition of the trail system. The trailhead at FR 237 and Pumphouse Wash will help to eliminate damage to riparian vegetation from uncontrolled parking. All the recreation management activities reverse deleterious effects from the current condition.

Table 15. Thinning Treatment Acres for Alternative A

Map Unit	OG[1]	Thin 40-100 BA 25 Percent Defer	Thin 40 to 120 BA	Thin 9-inch or less Owl	Thin 9-inch or Less By Hand	GH[2]	WL[3]	Total	Erosion Hazard
53	2	3	12	0	1	0	0	17	Slight
55	0	0	5	0	12	0	0	17	Slight
60	0	0	0	0	0	0	0	0	Slight
471	0	4	15	0	0	0	0	19	Severe
536	0	0	69	0	0	0	0	69	Moderate
546	96	433	67	228	0	103	10	937	Slight
550	2	0	66	0	42	0	0	110	Moderate
555	8	111	35	99	0	9	63	325	Moderate
570	0	0	662	0	26	0	0	688	Slight
575	0	0	0	0	0	0	0	0	Severe
578	0	165	0	30	0	0	0	195	Slight
582	218	723	816	36	0	0	70	1863	Slight
584	42	108	173	56	0	0	0	379	Moderate
585	51	109	6	6	0	11	0	183	Slight
Total	419	1,656	1,926	455	81	123	143	4,802	

[1] Improving Old Tree Longevity and Gambel Oak Habitat (Variable thinning around old trees and Gambel oak)

[2] Dense Canopy Retention for Improving Forest Resiliency of Goshawk Habitat (Variable thinning to average of 80 BA with openings created)

[3] Wildlife Movement Corridor

Broadcast 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. Litter and/or vegetation cover bare soil in 1 to 2 years on this forest (Lindenmuth 1960; Davis and others 1968; Sackett and others 1993). Total consumption of ground cover will be patchy and will not adversely affect overall ground cover. Low severity fires burning only surface fuels do not considerably heat the soil surface. Soil temperatures do not rise substantially where repeated cool-burning fires are used to reduce fuel buildup (Debano et al. 1998).

Pile burning thinning slash may cause small patches of soil heating to the point where soil characteristics are changed. These patches are small in relation to the project area.

Alternative A intends to rehabilitate 17.65 miles of existing roadway by closing, scarifying, and re-vegetating, approximately 56 percent of the Forest Service roads in the project area. These areas will not likely return to full productivity for many years, but will become stable after only a few years. The area of rehabilitated roadway amounts to 43 acres. This reduction in amount of roadway improves on the current condition and lessens site-specific erosion related to roads.

Under Alternative A, an additional 5.75 miles of road will be re-opened for temporary haul roads. Temporary roads are defined as roads associated with a timber harvest contract, not intended to be a part of the forest development transportation system, and not necessary for resource management (FSM 77-5.7/27/94). Roughly 90 percent of these temporary roads have been constructed, used, and rehabilitated through previous harvest entries. Some new construction will be required to relocate or substitute for undesirable existing temporary road locations. Temporary roads have fewer adverse effects than permanent roads, as they will be decommissioned shortly after use. These previously used roads are stable in terms of soil movement but are relatively unproductive compared to undisturbed forest land. These additional roads amount to 14 acres of unproductive forestland. The temporary addition of these acres does not affect overall watershed health. Onsite soil quality effects from temporary roads are minimal and BMP's will mitigate onsite effects.

Roads also contribute to the invasion of exotic (non-native) plant species dispersed by wind, water, vehicles, and other human activities, as the disturbed areas serve as an avenue for establishment of exotic species into a new landscape. Invasion by exotic species may have unwanted biological and ecological effects if those species are able to displace natives or disrupt the structure and function of an ecosystem. The overall roadway reduction will lessen potential spread of invasive and noxious weeds via roads on the project area. Temporary roads will cause a short-term increase in the potential spread of invasive and noxious weeds. Mitigation measures will be applied to limit spread of invasive and noxious weeds.

The current road system is fairly well designed so as to reduce road-related surface erosion at the scale of individual road segments. The open road network described under Alternative A incorporated key factors such as road location, particularly layout relative to stream systems, road drainage, surfacing, and cut slope and fill slope treatments. Surfacing materials reduce the yield of fine sediment from road surfaces. Drainage structures will be maintained in all roads as appropriate to assigned maintenance levels. Proper drainage will reduce the off-site transport of sediment.

There are no direct effects to soil and water quality from the fence and structure removal at Kelly Seep.

Direct Effects of Alternative B

There are no direct effects to soil quality from the No Action Alternative.

The No Action Alternative does not produce new roads and, therefore, results in no change.

Direct Effects of Alternative C

The direct effects for Alternative C are similar to Alternative A.

Direct Effects of Alternative D

The direct effects for Alternative D are similar to Alternative A.

Direct Effects of Alternative E

Alternative E will require 2.5 miles of temporary road, or 6 acres of unproductive forest land. This is roughly half the number of miles of temporary road required under Alternatives A, C and D. Because soil effects are minimal due to BMP's, the difference between the alternatives is not extensive. (See Table 16.)

Table 16. Comparison of the Miles or Equivalent Acres of Temporary Road, Road Maintenance, and Rehabilitated Roads for Each Alternative.

Alternative	Temporary Road Miles	Temporary Road Acres	Road Maintenance Miles	Road Maintenance Acres	Rehabilitated Miles	Rehabilitated Acres
A, C and D	5.75	14	36	87	17.65	43
B	0	0	0	0	0	0
E	2.5	6	36	87	17.65	43

In Alternative E, treatment acres and erosion hazard are the same as the other alternatives. The difference in this alternative is that only 2,330 acres will be mechanically treated (a little over half of the other alternatives). Consequently, we can expect approximately half of the impacts to soil quality and productivity described for Alternative A to occur. Some compaction from skidding equipment will occur in all treatment areas where machines are used (roughly 1,890 mechanical treatment acres). No skidding compaction or ground cover disturbance will occur where hand thinning is done (roughly 2,326 hand treatment acres). Some onsite soil loss will occur on soils with moderate erosion hazard (405 acres). Because the mitigation measures described in the soil and water mitigation section will be followed, there will be only minor impacts to onsite soil quality and productivity from any of the action alternatives. The effects from Alternative E will be slightly less due to limited equipment use south of Kelly Canyon.

Table 17. Thinning treatment acres for Alternative E[1].

Map Unit	Intensive[2]	Thin 60 to 120 BA	Thin 9-inch dbh Tree and Less by Hand	Thin by Hand; No Roads	Total	Erosion Hazard
53	6	3	0	5	14	Slight
55	4	0	0	13	17	Slight
60	0	0	0	0	0	Slight
471	0	15	4	0	19	Severe
536	20	15	0	34	69	Moderate
546	12	264	661	1	938	Slight
550	45	18	0	48	111	Moderate
555	0	113	210	2	325	Moderate
570	273	200	0	215	688	Slight
575	0	0	0	0	0	Severe
578	0	0	196	0	196	Slight
582	48	1,056	721	0	1,825	Slight
584	32	162	164	21	379	Moderate
585	0	44	153	24	221	Slight
Total	440	1,890	2113	363	4,803	

[1] The old tree longevity, wildlife movement corridor and dense canopy retention for goshawk are not shown in this table because they are the same as under Alternative A.

[2] Intensive Zone Thinning – Adjacent to Private Land (variable thinning 40 to 50 BA).

Indirect Effects of Alternative A

The combination of thinning to open the stand and burning will likely result in the promotion of herbaceous vegetation over litter as the major component of ground cover. Protection against erosion occurs the same whether the forest floor is covered with needlecast and woody material or herbaceous ground cover. So there is no difference between the alternatives from a soil and water quality perspective related to the number of openings. The benefit of herbaceous ground cover is nutrient cycling into the soil that maintains and enhances future herbaceous growth.

Stand canopy conditions and fuel loading will be reduced so that the potential effects of intense wildfire are reduced. The effects of wildfire are discussed in more detail under Alternative A.

Some negative potential off-site[15] effects associated with the Kachina Village Forest Health Project include sedimentation from ground-disturbing activities and potential short-term increases in runoff from disturbed surfaces. Adequate buffers have been developed on all major drainages in the area. Only a small portion of anticipated soil loss will travel off-site and enter ephemeral stream channels. Most of this sediment will remain in storage rather than move downstream into Oak Creek.

There are no indirect effects to soil and water from rehabilitation activities at Kelly Seep.

Indirect Effects of Alternative B

Alternative B will perpetuate stand conditions that are conducive to the occurrence of intense wildfire. On- and off-site impacts on hydrologic function resulting from severe fire include:

- Precipitation flowing on the surface of the soil rather than infiltrating it;
- Excessive erosion during precipitation events;
- Rapid stream flow response from precipitation; and
- A reduction in base flow between storms.

As forest canopy and protective organic matter is consumed by severe fire, interception is reduced and soil erosion is increased.

Changes in forest canopy cover can affect snow accumulation and melt patterns by creating large openings. Consequently, the timing, quantity, and quality of runoff from severely burned watersheds are altered. Changes in soil and watershed conditions become more considerable as fire size and intensity increase.

Wildfire can have major effects on vegetation, ground cover, and soil properties, resulting in reduced infiltration and increased overland flow. Intense wildfire can reduce soil surface resistance to erosion, resulting in accelerated soil erosion particularly because of heavy summer precipitation. Peak discharges are likely to increase because of wildfire, and water quality is likely to decrease due to increased sediment loads.

The degree to which soil is heated depends on a variety of factors, including soil moisture, fuel loading, fuel moisture, fuel distribution, soil texture, and others. The peak temperature and duration of heating greatly influences subsurface soil temperature. The amount of change in soil properties is largely dependent on the amount of energy radiated downward into the underlying duff and mineral soil. The amount of heat radiated downward increases as fire severity increases. If a wildfire burns hot, then negative impacts to soil could occur from soil heating. Soil heating may cause changes in soil properties, such as reduction of structure and porosity and changes in soil color. Burning reduces soil organic matter and soil plant and litter cover. In most cases, soil erosion by wind and water is increased. The severity and duration of accelerated erosion depends on slope, soil texture, recovery of plant material, severity and extent of burning, and post-fire precipitation timing and intensity. The duration of the fire effects on soil structure depend on the severity of the fire and rate of recovery. The duration may last from 1 year to many decades (Wells et al. 1979).

High degrees of soil heating can destroy soil structure, thus affecting soil pore size distribution and overall porosity. This reduces infiltration rates and increases overland flow. Soil water repellency is increased as organic matter is heated. The more severe the fire, the deeper the water repellant layer, unless heating is so intense that surface organic matter is destroyed.

Alternative B will produce no dispersed camping management, trail management, or road management. Deleterious trends will continue in the site-specific locations that are currently receiving heavy dispersed camping use. The current level of landscape dedicated to roadways (and not vegetation) will continue.

Indirect Effects of Alternative C

The indirect effects of Alternative C are similar to Alternative A.

Indirect Effects of Alternative D

The indirect effects of Alternative D are similar to Alternative A.

[15] Off-site means an effect that occurs downstream from the treatment area.

Indirect Effects of Alternative E

Stand canopy conditions and fuel loading are reduced but not as much as in Alternatives A, C, and D. Risk of fire is higher than Alternatives A, C, and D in the areas south of Kelly Canyon. The combined thinning and burning will promote herbaceous vegetation over litter more than B but less than A, C, and D. Off-site effects are less than A, C, and D because potential for short-term runoff from disturbed areas is less because of fewer acres with mechanical treatment. Under Alternatives A, C, and D only a small portion of anticipated soil loss will travel off-site and enter ephemeral stream channels. Most of this sediment will remain in storage rather than move downstream into Oak Creek. Therefore, the difference between Alternative E and the other action alternatives is negligible.

Cumulative Effects of Alternatives A, C, and D

An appropriate area to consider cumulative effects is the Pumphouse 6th code watershed. The few acres associated with the Fry Canyon watershed are located at the bottom of the canyon at the confluence with Pumphouse Wash. Pumphouse Wash is a tributary to Oak Creek and is, therefore, subject to the same stringent water quality standards as Oak Creek.

Actions considered for this section are those activities that occurred in the Pumphouse 6th code watershed in the past 10 years. Activities are described at the beginning of this chapter. Impacts from activities that occurred more than 10 years ago are unlikely to be evident today.

The cumulative effects of land-disturbing activities can be seen on site or downstream of the activity. Onsite effects include changes to soil characteristics, vegetation, and nutrient cycling.

There are no grazing effects associated with the Kachina Village Project and, therefore, no cumulative effect added to grazing activities on existing allotments within the watershed.

The minor effects to soil quality of machinery use in thinned stands can be considered cumulative with similar activities in the Pumphouse Multiproduct Timber Sale (approximately 776 acres) and the State Trust Land Section 26 (1/2) where a pulpwood sale of less than 12-inch diameter trees occurred 5 years ago. Currently slash piles exist on this section of state land. Future planned activities on Section 26 are to re-pile and burn the existing slash piles, and conduct pre-commercial thinning. The effects to soil and water quality from Alternative A are minor and do not add cumulatively to surrounding projects in a way that causes a negative overall effect.

Recreational use in the Pumphouse watershed is moderate to high. Recreation uses will probably increase in the future. Individuals and groups use the area. Activities include hiking, horseback riding, bicycling, jeep driving, off-highway vehicle driving, dispersed camping, and camping in developed campgrounds. In some places throughout the watershed, recreation use causes one or more of the following effects: loss of vegetative ground cover, soil compaction, localized erosion, increased runoff and biological pollution. The effects to soil quality of recreation management activities are positive and do not combine with activities in other areas in a way that causes a negative cumulative effect. The effects to soil quality of recreation management activities under Alternative A are positive and will serve to offset, to some extent, the negative impacts in the remainder of the Pumphouse watershed. It is difficult to speculate where campers displaced from areas in the Kachina Village Project will go. There may be increased dispersed camping and subsequent impacts on the west side of Highway 89A along FR 545. Some campers may continue into Flagstaff. Because the campers in this area do not travel very far off of paved roads, it may be that many of them seek out other paved road forest access that lies outside of the Pumphouse 6th code watershed.

The effects of broadcast burning are negative for the short-term, or 1-2 years until herbaceous ground cover or needlecast is re-established. After this, the effect of broadcast burning on soil quality is beneficial. Other broadcast burning projects occurring in the Pumphouse 6th code watershed include a portion of the Airport Project (of the 1,000 acres in this project, approximately 200 are in the Pumphouse 6th code watershed). The timing of these burns is regulated through the ADEQ permitting process for air quality. Therefore, the number of acres burned at one time in the watershed is not enough to cause a cumulative negative effect.

Under Alternative A, only a small portion of anticipated soil loss will travel off-site and enter ephemeral stream channels. Most of this sediment will remain in storage rather than move downstream into Oak Creek. Therefore, there is very little added effect to off-site effects when combined with other activities in the Pumphouse 6th code watershed.

Alternative A reduces the overall amount of landscape taken up by roadway and, therefore, has a beneficial effect when added to other areas in the watershed. This same beneficial trend is occurring on other areas within the Pumphouse 6th code watershed. The objective for managing the road system on the Coconino National Forest within these watersheds is to limit overall road densities to 2 miles per square mile. With the exception of private land development few, if any, new roads need to be constructed for activities proposed in the Pumphouse watershed. Some roads have been closed or obliterated recently and additional closures and obliterations are expected in the future. Existing open National Forest System roads will be maintained at levels suited to their uses and locations. As timber sales continue to decline, so will the periodic road maintenance associated with sales. Funding appropriated for maintenance of forest system roads is also declining. Some funds have and will be invested in road closures, obliteration, and drainage maintenance.

Alternative A creates 5.75 miles of temporary road. One other project used temporary roads within the Pumphouse 6th code watershed: the Pumphouse Multiproduct Sale had an estimated 2 miles of temporary road. The Airport Fuels Reduction Project does not have temporary roads. When added together, these projects do cause a significant cumulative effect related to temporary roads.

In conclusion, it appears that the Proposed Action will not pose a significant cumulative effect in association with other activities in the watershed. Assuming soil and water mitigation measures are employed, the harvest burning treatments proposed in Alternative A would have little incremental cumulative effect when considered with the effects of past and future projects. These treatments will have little direct or indirect effect on soil condition and water quality. Treatments in Alternative A are designed to reduce the likelihood of landscape level wildfire and the watershed disturbing effects associated with such a fire. Improvements in road and recreation management would improve soil condition in the long-term and consequently have a positive effect on soil condition and, perhaps, downstream water quality.

Cumulative Effects of Alternative B

Alternative B (No Action) with wildfire could result in the greatest impact to soil condition and water quality and, therefore, the greatest cumulative effect. A severe crown fire would result in large increases in soil movement and runoff for at least a few years.

Cumulative Effects of Alternative E

The cumulative effects for Alternative E are similar to Alternative A, except that canopy closures will be somewhat higher south of Kelly Canyon and risk of catastrophic wildfire in that area will be greater than Alternatives A, C, and D and less than Alternative B.

Alternative E creates 2.5 miles of temporary road, which is a smaller addition to the effects to temporary roads in other areas within the Pumphouse 6th code watershed.

Alternative E has less potential off-site effects because fewer acres receive mechanical treatment. The addition of off-site effects to other projects in the 6th code watershed is less than Alternative A.

Recreation Setting and Opportunity

Affected Environment

The project area provides many year-round recreation opportunities because of its close proximity to Flagstaff and Oak Creek Canyon, and because of its diverse landscape of pine forest and canyon country. Local residents of Kachina Village, Forest Highlands, and Pine Del use the areas north of Kelly Canyon, east of Pumphouse Wash, in the Griffiths Spring area, and Kelly pit on a daily basis for walking, hiking, mountain biking, OHV riding, rock climbing, exercising pets, wildlife viewing, target practice, firewood gathering, and winter recreation activities. A considerable amount of use by non-local recreationists occurs along Highway 89A, including camping, hiking, driving for pleasure, and viewing wildlife and scenery.

Recreation setting characteristics and recreation opportunities for the affected area have evolved over the last century from primitive settings with only rare evidence of human presence to a mostly natural appearing area with moderate evidence of human activity, mostly roads. Primary access from outside the project area is from I-17 and Highway 89A via FR's 237, 631, 253 and the non-numbered road into Mexican Pocket. Additional primitive roads have developed over time as people have passed over the natural ground in vehicles with enough frequency

for a road to develop. Recreation setting objectives defined in the Forest Plan for the area include Roaded Natural[16] for areas adjacent to primary roads; and Semi-Primitive Motorized[17] for areas accessible only by primitive roads.

Several popular areas provide dispersed camping opportunities in the ponderosa pine forest and in campsites with scenic views of the canyons. Most camps are located along main Forest Service roads, via a single 2-track road. Popular camping sites are along FR's 237 and 535, Kelly Canyon exit, Mexican Pocket, and Sterling Canyon. Over the last several years, dispersed camping in this area has progressed from nice scenic campsites overlooking Oak Creek Canyon to unsightly campsites with no ground vegetation, chopped up green trees, multiple fire rings, litter, toilet paper, and scattered human waste. As the current dispersed campsites are occupied—especially during weekends and holidays—new user-created, 2-track roads are created with new campsites established every year.

This project area has seen an increase in camping use over the last several years. The greatest increase in use and resource impacts is along the Highway 89A corridor that encompasses 1/2 mile on either side of the highway. As a result of the limited number of camping sites in Oak Creek Canyon, recreationists have found Highway 89A north of Oak Creek Vista a good place to camp. As a result of this increased use, the Forest Service has seen an increase in human-caused fires and resource damage in this area. This area receives the highest use during weekends and holidays, where it isn't uncommon to see groups of 50 or more people camping along FR 237 and in Sterling Canyon.

There are approximately 544 dispersed campsites in the project area that have been inventoried, identified with GPS coordinates, and placed in our GIS system. An additional 100 dispersed campsites have not been inventoried. Primary season of use for these areas is the summer months from May through September with some fall use during hunting season. It is estimated that during a busy summer weekend many of the sites are in use. The exact number of people using these campsites has not been calculated.

There are two non-motorized Forest Service system trails in the project area: Griffiths Spring (1-mile long interpretive loop trail) and at Oak Creek Vista (a short .2-mile paved trail).

The other trails in the area are user-created (non-motorized and motorized) from area residents who live in Kachina Village, Forest Highlands, and Pine Del and access the forest on a daily basis. Residents access the forest from their backyards, from two main access points off Toho Trail Road, and near the water treatment plant in Kachina Village. The area west of Kachina Village along Pumphouse Wash is closed to motorized vehicles. The old roads that have been closed to motorized use in Pumphouse are now used on a daily basis for hiking and jogging, and are not part of an official Forest Service trail system.

In addition to the numerous user-created trails near the residential areas, users also like to explore the canyons. There are three main canyons in the project area: Pumphouse Wash, Kelly Canyon, and James Canyon. These canyons are popular for canyoneering, hiking, photography, wildlife viewing, and rock climbing.

Direct Effects of Alternatives A, C, D, and E

The effects described in the "Aesthetics" section earlier in this chapter will result in more esthetically pleasing recreation settings throughout the project area. These alternatives are identical in how they treat system and non-system roads in the area, and in how they differ from the existing condition. These alternatives will not affect the total area of vehicular access but will decrease road densities in some of the more heavily roaded areas; thereby increasing opportunities for solitude and ability to get away from the sights and sounds of other people that contribute to the overall "primitiveness" of forest settings. In general, some arterial and secondary roads will remain open, allowing access to most areas that are now accessible by vehicle. The Mexican Pocket area will be closed to vehicles. There will be more administrative presence in the form of signing and patrols to enforce restrictions, which will tend to create a less primitive setting.

[16] RN - easy vehicle access, sight and sound of other people common, moderate to low opportunity for solitude and "challenge and risk," moderate scenic integrity.

[17] SPM - primitive roads, sights/sounds of others uncommon, moderate/high opportunities for solitude and "challenge and risk," high scenic integrity.

All action alternatives would provide opportunities for dispersed camping in designated dispersed campsites. Campfires would be allowed only in designated dispersed campsites and would substantially reduce the probability of escaped campfires. Campsites in designated areas would allow contact that is more frequent with Forest Service personnel and improve compliance. This alternative may restrict recreational pursuits and may cause a loss of perceived freedom by reducing campsite locations. The number of traditionally used dispersed campsites will be reduced for management purposes. It is estimated that camping opportunities along the Highway 89A corridor will be reduced by at least half over time. The total amount of people this will affect is not calculated. A likely result will be competition for the designated dispersed campsites and the possibility for the creation of new dispersed sites outside of the closure area. This alternative, while environmentally beneficial, has the potential for social conflicts.

The trail and trailhead improvements proposed are the same for all action alternatives and would directly affect and improve recreational resources and values. The access and safety of users would be improved and the trail system would be maintained on a scheduled basis. Additionally, the measures would provide protection to the local environment from resource damage. The action alternatives would add approximately 9 miles of new trail to the Forest Service trail system.

The designated trail systems south of Kachina Village, south of Griffith Springs, and in the Mexican Pocket area will be located using existing user-created trails and roads where appropriate. Based on site-specific analysis, the trails would be located through non-sensitive areas and/or in areas previously disturbed. The trails would be constructed, maintained, and signed to Forest Service standards for safety and to minimize soil, water, wildlife, cultural, and vegetation impacts. It is estimated that over half of the new trail will be on existing closed roads or social trails thus limiting new construction.

The construction of a trailhead would directly impact the soil through grading and construction activities. The trailheads would be graveled, thereby converting the soils onsite into an impermeable surface capable of withstanding concentrated visitor use. The trailheads would be clearly delineated to deter users from dispersed parking to prevent trampling and damage to sensitive plant communities.

All action alternatives contain thinning and burning, therefore affecting the view from trails and temporarily affecting the quality of some recreation activities. Stands may be noticeably less dense and slash piles, skid trails, or log landings may be visible for a short time during the activity and after it ceases. There could be short-term disruptions for recreationists while the work is being completed. These disruptions would include noise, traffic, and rehabilitation activities on the trails. These disruptions would be minor and short term.

Timber cutting activities could potentially affect trail and trailhead locations. Alternatives will incorporate mitigation measures requiring the purchaser to obtain approval from the Forest Service for log landing, skid trail locations, or slash piles.

There are no effects to recreation from the riparian rehabilitation project at Kelly Seep.

Direct Effects of Alternative B

The No Action Alternative will have no direct effect on existing recreation settings or opportunities within the project area.

Indirect Effects of Alternatives A, C, D, and E

Recreation settings will become more esthetically pleasing (see “Aesthetics” earlier in this chapter) with these alternatives than with the No Action Alternative. This will likely increase recreation use compared with use resulting from the No Action Alternative, although total use is likely to remain low in the SPM areas (areas accessed via primitive roads) with any alternative.

An indirect effect of the action alternatives would be the possible temporary displacement of recreationists while the activities are completed. Recreationists using facilities both within and outside the project area that are not affected by this alternative could notice more use, which could negatively affect their recreation experience. This type of displacement could occur during harvest, rehabilitation, and broadcast burning. However, the effect would be minor, as all of the activities would be scheduled over a number of years.

The proposed trail plan and trailheads for Alternatives A, C, D, and E will benefit the long-term recreational trail resource in the project area. The combined actions would provide substantial improvements to a heavily-used social trail network,

prevent further resource damage due to an unmanaged trail system, and rehabilitate areas damaged by overuse.

Indirect Effects of Alternative B

Recreation settings in the project area will either retain existing landscape character trends, or will assume characteristics of fire-altered landscapes if wildfires occur. Over time, as the scenic quality of recreation settings across the project area decreases (see aesthetics section) and differences in vegetative pattern become more apparent, other local areas receiving different management are likely to become more attractive to many people. Opportunities for solitude and escape from the sights and sounds of other people will continue to diminish as non-regulated recreation use continues to increase. Volunteer or user-created roads will increase and will cause additional visual impacts. The extent of the area meeting Roaded Natural ROS setting will continue to expand at the expense of the more primitive Semi-Primitive areas.

Dispersed camping under Alternative B (No Action) would allow camping to continue as it is today and provides the greatest amount of freedom because there would be fewer restrictions where people could choose to camp. It is expected that in the future more dispersed camping areas would become established and result in greater resource and sanitation problems. The potential for escaped campfires from campers as well as partygoers would likely increase as the population grows around Flagstaff and tourism increases. Perceived threats to private property would likely increase as would complaints concerning activities associated with dispersed camping.

Alternative B (No Action) would have the greatest potential for a large, catastrophic fire that could substantially damage recreation resources and user experience in the project area. An indirect effect of a No Action Alternative would be a continuation of the trend toward increasing forest fuels and fire risk. Alternative B would also essentially leave the user-created trail system as it is today with the potential for the user-created trails to grow as residents and visitors attempt to avoid crowded areas. Adverse effects include soil erosion, habitat fragmentation, and the spread of noxious and invasive weeds. This area is heavily used for recreation, and users could be displaced to other areas which would put additional pressure on other nearby areas and facilities.

Cumulative Effects of Alternatives A, C, D, and E

The actions considered in this discussion are those that have occurred in the recent past (10 years). Management activities that occurred prior to this time helped create the current condition described under the affected environment section. The people that recreate in the Kachina Village area are primarily: 1) adjacent landowners; 2) weekend campers or day-use recreationists coming up from Oak Creek Canyon; and 3) local residents enjoying primarily daytime activities such as climbing and mountain biking. Since people can range far and wide in search of recreation interests, it is difficult to choose an area for considering cumulative effects. For this discussion, actions to consider are those that occur in areas immediately within or adjacent to the project area. These are:

- Griffiths Spring parking area and trail development.
- Ongoing use of the Oak Creek Vista Overlook.
- Ongoing use of the Fort Tuthill Campground and Day Use Picnic Areas.
- Ongoing dispersed recreation on lands surrounding the Kachina Village Project.
- The Fort Tuthill to Kachina Village Trail (in the planning stages).
- Ongoing social trail use adjacent to communities such as Pine Del, Mountain Dell, and Mountainaire.

The continuation and enhancement of Semi-Primitive Motorized recreation settings will add to the presence of that setting in the surrounding landscape. Surrounding areas are also likely to maintain and enhance some Semi-Primitive settings. The exact amount is unknown.

The positive effects of changing to designated dispersed camping along the Highway 89A corridor will offset deleterious effects of heavy dispersed camping in adjacent areas.

Although it is difficult to estimate where displaced campers may go, we estimate that major forest roads outside of the Kachina Village area may see increased use. In addition, more people may travel to Flagstaff and use the Fort Tuthill or private campgrounds. Displaced campers will not affect Oak Creek Canyon because strict camping rules are in

place for that area. Displaced campers may add to current camping impacts in adjacent areas causing a slight increase in resource impacts.

A new Forest Service trail proposed will add to existing trail opportunities at Griffiths Spring and Fort Tuthill. The Fort Tuthill to Kachina Village Trail will add a link between communities and to the Flagstaff Urban Trail System. No other trails are currently planned in the remainder of adjacent areas.

Better design and signing of Forest Service trails will offset deleterious trends of poorly located user-created trails in surrounding areas.

Cumulative Effects of Alternative B

Roaded Natural settings may increase over time and Semi-Primitive settings may decrease. This would offset other areas where Semi-Primitive settings are likely to increase due to road and vegetation management.

Continuation of resource impacts due to high levels of dispersed camping will add to deleterious trends in adjacent areas.

Continuation of resource impacts due to poorly located social trails will add to similar effects in adjacent areas.

Cumulative effects for Alternative B (No Action) resulting in a wildfire would be visible throughout the area. The trails and general areas that were once used for recreational activities would be less attractive, thus affecting the setting and user's experience. The area would be closed until it was safe to re-enter and all rehabilitation work was completed. Should high intensity crown fire occur, many recreation activities might be displaced to the surrounding landscape, adding impacts to surrounding lands and increasing competition and possibly conflict between users.

Wildlife Habitat - General

Coconino Forest Plan Direction

The Forest Plan standards and guidelines for managing wildlife habitat were developed to meet the needs of MIS, threatened, endangered and sensitive species on the Coconino National Forest. The Kachina Village Forest Health Project (FHP) meets standards and guidelines in the Forest Plan and meets all monitoring requirements. Habitat quality index modeling was conducted for MIS species. Threatened and endangered species were addressed through consultation with the USFWS. Sensitive species are managed in accordance to existing management plans for priority species.

Not all desired conditions in the Forest Plan can be achieved with a single action. Often many actions are necessary over time that progress toward desired conditions as outlined by standards or guidelines. Since the Forest Plan is a permissive document, if an action progresses toward, but does not preclude nor deviate from Forest Plan direction, then the action meets the intent of the Forest Plan. An example of this is vegetative structural stage (VSS) distribution described in the northern goshawk section of the Forest Plan. The amount and distribution of thinning activities planned is focused on reducing fire hazard by removing trees that facilitate the movement of fire from ground level up into the crowns. The forest canopy would be broken up with some small openings that will result in some increase in herbaceous vegetation and pine tree seedlings. This project will also facilitate the growth of larger trees, thus progressing toward that component of goshawk habitat. At this time, treatments are not designed to facilitate the establishment of pine seedlings (regeneration). Although these thinning actions make progress toward the desired VSS distribution that the goshawk guidelines indicate, this entry will not focus on increasing VSS 2 (pine seedlings and saplings). Future thinning[18] entries could maintain openings, begin regeneration treatments, and maintain the forest structure with low fire hazard.

Species viability analysis as required in NFMA is appropriately addressed at the Forest Plan level. The Forest Plan requires monitoring for all MIS through habitat capability modeling. As specified in the Forest Plan, some species require field surveys to determine population numbers, which the Arizona Game and Fish Department collects. Monitoring for threatened, endangered, and sensitive (TE&S) species is planned to address those species on a priority basis. The USDI Fish and Wildlife Service assists in tracking populations of threatened and endangered species.

[18] Future actions will occur based on future NEPA decisions.

Vegetative Structural Stages and Canopy Cover

Vegetative structural stage (VSS) data, an important component in describing habitat, was used to analyze the effects for the northern goshawk, MIS species, and old-growth. VSS data is provided below for three time periods: immediately following treatment, and years 20 and 50 following proposed treatments. Each table and graph illustrates VSS class and canopy closure for all action alternatives and No Action for the three time periods. VSS data was collected for the project area prior to planning. VSS post-treatment data modeling was calculated with the aid of Forest Vegetation Simulator modeling (PRD 130).

Table 18. Percent Vegetative Structural Stage (VSS) Immediately Following Treatment for Each Alternative.

Percent VSS	VSS 1	VSS 2	VSS 3	VSS 4	VSS 5	VSS 6
Existing Conditions (Alt. B - No Action)	0.5	5	61.5	24	6	3
Alternatives A and D	5.5	3.5	26	52	10	3
Alternative C	3	3.5	26	54.5	10	3
Alternative E	1	4	40	43.5	8.5	3
Desired from Forest Plan	10	10	20	20	20	20

VSS Immediately Following Treatment and Under No Action

Alternatives A and D would exhibit VSS distribution that would more closely approximate desired conditions than the other alternatives, including the No Action Alternative. Alternative C closely approximates Alternatives A and D. To account for the creation of grassy openings, 10 percent of 3,891 acres (as described in the Proposed Action) were included in VSS 1 class for Alternatives A and D; 5 percent of 3891 acres for Alternative C; and 10 percent of 439 acres from the intensive treatment zone for Alternative E. Based on the professional opinion of Forest Service specialists, creation of grassy openings would be difficult to achieve in many of the treated stands for Alternative C, and it would be very difficult to create any grassy openings under Alternative E. This estimation for grassy openings included here is for VSS class comparison in relation to northern goshawk guidelines and is for representative purposes. (See Table 18.)

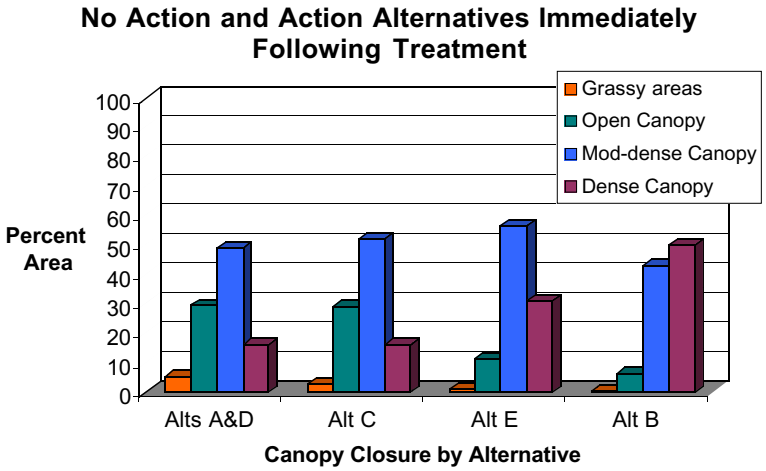

Figure 23. Canopy Closure Immediately Following Treatment for Each Alternative.

Canopy Closure Immediately Following Treatment and Under No Action

Canopy closure is defined as open (<40 percent canopy cover), moderately dense (40 to 60 percent canopy cover), and dense (>60 percent canopy cover). To account for the creation of grassy openings, 10 percent of 3,891 acres were included in VSS 1 class for Alternatives A and D, 5 percent of 3,891 acres for Alternative C; and 10 percent of 439 acres from the intensive treatment zone for Alternative E.

Under the action alternatives, the overall canopy of the forest would change from one that is dense to one that is moderately dense. Canopy closure for Alternatives A and D would be the same, and Alternative C would be very similar to Alternatives A and D. Alternatives A, C, and D would reduce dense canopies in the project area more than Alternative E. There would be no change under Alternative B. Alternatives B and E would have the effect of allowing the potential of a large wildfire to remain high (see fire effects analysis section). Alternatives A and D would decrease wildfire potential, specifically potential for a crown fire, the greatest due to the greater reduction of dense canopies and the creation of more open, grassy areas. Similarly Alternative C would decrease wildfire potential, although slightly less than Alternatives A and D due to the lesser amount of grassy openings created.

VSS 20 Years Post-treatment and Under No Action

The 20-year post-treatment would be similar in VSS composition for all action alternatives. Each action alternative shows VSS 3 meeting the desired condition, an overabundance of VSS 4, and a shortage in the remaining VSS classes. Primarily there would be a gain of sites in the VSS 4 class, and decreases in the VSS 3 and VSS 5 classes under all action alternatives. There would also be a slight decrease in VSS 2. VSS 6 would be unchanged as compared to initial time. Even with broadcast burning occurring, some pine seedlings will likely establish within openings over time. Seedlings may be patchy depending on the schedule and intensity of broadcast burning. VSS 1 was, therefore, held constant from current condition for this analysis. Alternative B (No Action) would continue to show an overabundance in the VSS 3 and VSS 4 classes with some trees shifting into the VSS 4 class. There would be a slight decrease in the VSS 2 class. The remaining VSS classes under Alternative B would be unchanged and continue to show shortages. (See Table 19.)

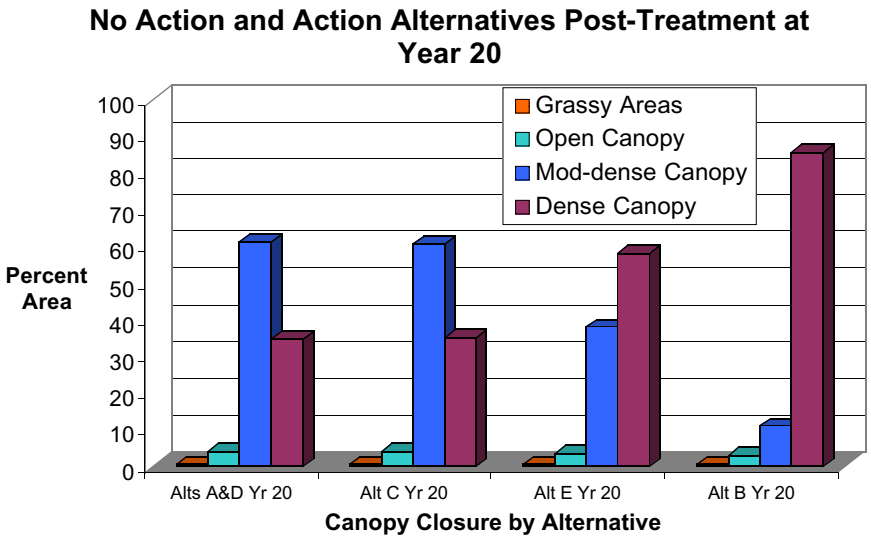

Figure 24. Canopy Closure at Year 20 for Each Alternative.

Canopy Closure Year 20

Analysis of canopy closure at 20 years post-treatment shows that the forest under Alternatives A, C, and D would be relatively the same in canopy closure with most of the forest being composed of moderately dense canopy (approximately 61 percent). Under Alternative E, the forest would be composed of approximately 58 percent dense canopy. Under Alternative B, approximately 80 percent of the forest would be mostly composed of dense canopies. The potential for a large wildfire event would remain high under Alternatives B and E. (See Figure 24.)

VSS 50 Years Post-treatment and Under No Action

Alternatives A, C, and D would be similar in VSS composition 50 years post-treatment. There would be an overabundance in VSS 4 class and a small excess in the VSS 5 class compared to desired conditions. All other VSS classes would show shortages, with no sites falling into the VSS 2 class. Without further treatment after initially treating stands, in 50 years there would be decreases in the VSS 2 and VSS 3 classes. VSS 4 showed an increase at 20 years but in 50 years, VSS 4 would decrease to be only slightly more than at the time of initial treatment. There would be an increase in VSS 5 class that would meet and exceed the desired condition. VSS 6, old-growth designation, would show a minor increase. VSS 1 was held constant from current condition in the analysis.

Table 19. Percent Vegetative Structural Stage (VSS) at Year 20 for Each Alternative.

Percent VSS	VSS 1	VSS 2	VSS 3	VSS 4	VSS 5	VSS 6
Alt. B (No Action) from existing conditions	0.5	3	53	34.5	6	3
Alternatives A and D (post treatment)	5.5	3	20	67.5	6	3
Alternative C (post treatment)	3	3	20	68	5.5	3
Alternative E (post treatment)	1	3	20.5	67.5	5.5	3
Desired from Forest Plan	10	10	20	20	20	20

Alternative E, 50 years post-treatment, would show an overabundance in VSS 4 and shortages in the remaining classes. VSS 2 and 3 would decrease, with no sites in VSS 2. Number of sites in VSS 4 and 5 would increase. VSS 6 would remain unchanged. VSS 1 was held constant to current condition in the analysis.

Alternative B (No Action), would continue to show overabundances in the VSS 3 and VSS 4 classes with some trees shifting into the VSS 4 class. VSS 2 would decrease to zero. The remaining VSS classes under Alternative B would be unchanged and continue to show shortages. (See Table 20.)

Table 20. Percent Vegetative Structural Stage (VSS) at Year 50 for Each Alternative.

Percent VSS	VSS 1	VSS 2	VSS 3	VSS 4	VSS 5	VSS 6
Alt. B (No Action) from existing conditions	0.5	0	33	57.5	6	3
Alternatives A and D (post treatment)	5.5	0	12	55.5	27.5	4.5
Alternative C (post treatment)	3	0	12	55	28	4.5
Alternative E (post treatment)	1	0	12.5	74	10	3
Desired from Forest Plan	10	10	20	20	20	20

Canopy Closure Year 50

After 50 years post-treatment and under no action, and with no further treatments in the project area, analysis of canopy closure shows that the forest under all alternatives would be relatively the same. Barring any wildfire events, approximately 91 to 94 percent of the forest would be composed of dense canopies. There would be no or very little open areas. (See Figure 25.)

Forest Fragmentation

Affected Environment

Forest fragmentation is described as a patch of forest within a sea of non-forested land, often surrounded by urban development or rural farms (Gladen 1999). The forest in the project area is currently dominated by VSS 3 class (62 percent), trees 5 to 11.9 inches in diameter. Most of the project area (50 percent) has canopy closure greater than 60 percent (C canopy) followed by a substantial amount of B canopy (40 to 60 percent closure; 43 percent of the area). The forest is contiguous across the project area with a few openings (0.5 percent) distributed throughout the area. The forest is not fragmented.

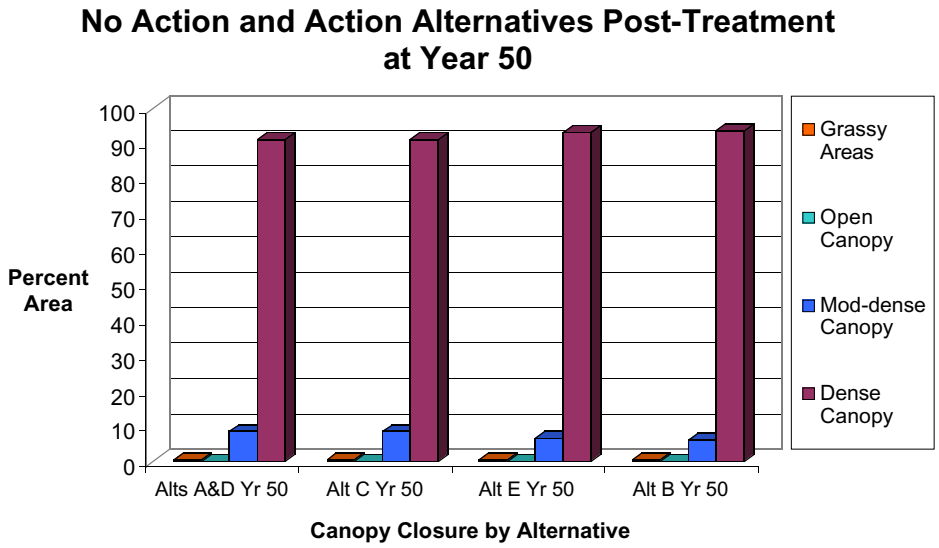

Figure 25. Canopy Closure at Year 50 for Each Alternative.

Direct Effects of Alternatives A, C, D, and E

Alternatives A and D would modify most of the sites into the VSS 4 class project-wide (52 percent) due to the removal of trees mostly smaller than 12 inches in diameter. Canopy closure would become predominantly B canopy (49 percent of the area). Some openings would be created (approximately an estimated 400 acres), increasing openings to 5.5 percent of the area. There would be some patches of trees, but overall the

patchiness is with the openings. Overall there would be a relatively contiguous forest canopy with variability in the level of canopy closure. The forest would not become fragmented.

Alternative C would be similar to Alternatives A and D. VSS 4 class would dominate post-treatment (54.5 percent). Canopy closure would also be dominated by B canopy (52 percent). Some openings would be created, approximately 200 acres estimated, increasing openings to 3 percent of the area. There would be some patches of trees, but overall the patchiness is with the openings. Overall there would be a relatively contiguous forest canopy with variability in the level of canopy closure. The forest would not become fragmented.

Alternative E would modify the overall VSS class distribution into one almost equally dominated by VSS 3 (40 percent) and VSS 4 (43.5 percent). Canopy closure would become predominately a B canopy (56.5 percent) with the retention of a substantial amount of C canopy (31 percent). There would be a slight increase in the amount of openings (approximately an estimated 44 acres) to 1 percent of the area. The forest canopy would remain contiguous across the project area, with some variability in the level of canopy closure north of Kelly Canyon. The forest would not become fragmented.

There would be no change under Alternative B (No Action). There is no additional forest fragmentation.

Indirect Effects of Alternatives A, B, C, D and E

There are no indirect effects to species because there is no forest fragmentation effect.

Cumulative Effects of Alternatives A, B, C, D and E

The forest would not become fragmented under any of the alternatives. Therefore, there is no added effect to forest fragmentation in the surrounding landscape. There is no cumulative effect regarding forest fragmentation.

Effects of Snag and Log Creation

This section describes the effects of the action to create snags and logs under Alternatives A and D. The Forest Plan does not provide standards and guidelines for creating log and snag structures. The Forest Plan does provide standards and guidelines for desired densities of snags and logs on the landscape. The Forest Plan states that within 10K blocks, at least 50 percent of the forested land meet the following criteria for snags: "At a minimum, snags are maintained at an average of 200 snags per 100 acres." Snag species will represent the tree species composition of the stand.

Under Alternatives A and D, snags will be created from some of the 16 inch and/or 18-inch black-barked trees. The creation of snags and logs will be guided by biological and watershed needs. Black-barked trees that are snags don't stand as long as snags created from old, yellow pine trees. The creation of snags from black-barked ponderosa pine has not been studied and the results of this activity are uncertain. The value of black-barked logs is unknown. Therefore, the Forest Service is approaching this application conservatively. The creation of snags and logs will be accomplished on the ground during layout; therefore, the actual number of snags and logs created is undeterminable at present.

Affected Environment

The mean number of snags per acre currently in ponderosa pine forests within the project area is 0.4, with standard deviation of 0.7 and range of 0 to 3.9 snags per acre. The mean number of logs per acre is 2, with standard deviation of 2 and range of 0-9.6 logs per acre. These averages are below the standards for both snags and logs, but more so for snags.

An analysis was completed October 2001 (PRD 120) to determine which sites have the conditions to allow for snag and log recruitment. Sites analyzed are located south of Kelly Canyon where wildlife use is higher. Conditions that allow for snag and log recruitment are based on two fundamental questions: 1) is there a need for snags and logs within a site, and 2) are there 16-inch or larger, black-barked trees within the site that could be converted to snags and/or logs. Analysis indicates that 28 sites in the area analyzed might be suitable for snag and log recruitment.

Losses of snags and logs from prescribed burning does occur and is estimated to be 20 percent loss of snags and 50 percent loss of logs (Randall-Parker and Miller 1999), although many will be protected using appropriate ignition and piling techniques, and lining of most snags. Randall-Parker and Miller (1999) also found that snags would continue to fall and provide new logs on the forest floor at a rate of 2 logs per 25 acres per year.

Direct Effects of Alternatives A, C, D, and E

Under Alternative A, snag and log recruitment would contribute to meeting the standards and guidelines, although the average number of snags and logs post-implementation might still be below standards. Additionally, with the retention of yellow pine trees and recruitment old-growth stands, some trees would in time naturally convert to snags, and the natural conversion of snags to logs would contribute to additional numbers of snags and logs on forests. Any created snags and logs will be monitored for use by wildlife species.

Alternative C would not include the component of creating snags and logs. There is little value of smaller (<16-inch diameter) snags and logs, therefore, efforts to create such smaller snags and logs is not feasible.

Alternative D would create snags and logs only from the 16 to 17.9-inch diameter class, thus fewer snags and logs would be created compared to Alternative A. This may not be a considerable difference. Any created snags and logs will be monitored for use by wildlife species.

Alternative E also will not include the component of creating snags and logs due to the 16-inch and 9-inch diameter limits outside the intensive treatment zone next to private property. There is little value of smaller (<16-inch diameter) snags and logs, therefore, efforts to create such smaller snags and logs is not feasible. There will be no snags or logs created within the “Intensive Zone”.

There will be no snag or log creation under Alternative B (No Action).

Indirect Effects of Alternatives A, B, C, D, and E

Snags created under Alternatives A and D would hopefully benefit cavity-nesting species, burrowing species and species that use snags as perches. Logs created under these alternatives would hopefully benefit small mammals, burrowing species and species that prey on small mammals.

There would be no indirect effects under Alternative C.

The high fire hazard potential would persist under Alternative B project-wide and under Alternative E south of Kelly Canyon. In the advent of a large wildfire, existing snags and logs would be lost. Wildfire would create snags by killing live trees, and these snags would eventually fall and become logs. Only snags and logs near edges of forested areas would be useful to wildlife because other necessary habitat components that support wildlife species would be lost in a large wildfire.

Cumulative Effects of Alternatives A, B, C, D and E.

Past silvicultural practices targeted the harvest of large diameter trees. This created the limited number large, old trees currently across the landscape, which in turn has limited the number of snags and logs that currently exist across the landscape. It was the large, old trees that naturally developed into snags, and the snags eventually became logs.

The broadcast burn effects on snags and logs are additive to similar effects in broadcast burning that have or will occur in the Pumphouse Multiproduct Timber Sale area, the Airport Fuels Reduction broadcast burn, and the Oak Creek Canyon Fuels Reduction Project. Burning occurs over time in these areas and does not impact large acreages at any one time. As in the Kachina Village FHP, large old trees will continue to replace snags slowly over time. Since efforts to retain snags through lining and burning techniques occur on all of the above-mentioned projects, the cumulative effect is not considerable.

Old-Growth

Affected Environment

The Forest Plan standards and guidelines for old-growth are that a minimum of 20 percent of ecosystem management areas be allocated to old-growth (page 70-1). In the Kachina Village FHP area there are 48 sites designated as existing or developing old-growth. There are 877 acres currently designated as existing old-growth, 11.4 percent of national forest lands. An additional 1,401 acres are designated as developing old-growth, 18.1 percent of national forest lands. Both groups total 2,268 acres of sites[19] managed for old-growth or 29.3 percent of the project area (Figure 26; PRD 132b).

Existing old-growth is defined as sites that currently display existing old-growth characteristics such as large, old-growth trees, abundance of snags and

[19] A site is a stand of trees usually of similar vegetation type and topography.

dead and down material. These sites meet or closely meet the old-growth definition of the Forest Plan. Existing old-growth sites were selected based on information obtained from field site reviews and surveys, databases from RMRIS and ArcView, and aerial photograph examinations. Most sites included under existing old-growth are those located in canyons, Mexican spotted owl PAC's (protected activity centers), the northern goshawk PFA (post-fledging family area), and the wildlife movement corridor.

Developing old-growth are those sites selected based on existing large yellow-pine trees (greater than 16-inches dbh) or large tree (greater than 18-inches dbh) densities which had higher numbers of these tree types compared to other sites within the project area. Black-barked trees greater than 18-inches dbh have the potential to develop into future old-growth trees sooner than smaller sized trees, and areas with large numbers of trees 18-inches dbh develop sooner into future old-growth stands than other areas that do not have large numbers of such trees.

Sites designated for old-growth management were selected to provide for a variety of wildlife species including Mexican spotted owl, northern goshawk, black bear, turkey, and brown creeper. Functions and interactions within old-growth areas, reproductive areas, feeding habitat, dispersal habitat, and prey species habitat are provided for.

Allocations of old-growth sites identified in the Kachina Village FHP EIS have been entered into the stand database and GIS layers at the project level. These allocations will be adjusted and official upon final decision for the Kachina Village FHP and entered into the forest level GIS layers.

Of the total acres of existing and developing old-growth in the project area, some are deferred from treatment. Old-growth mixed conifer habitat, 135 acres, has been deferred from treatment across all action alternatives. This existing old-growth habitat is found within a Mexican spotted owl PAC. In addition, 976 acres of ponderosa pine and pine-oak habitat are deferred from treatment across all action alternatives, consisting of 359 acres of existing old-growth and 617 acres of developing old-growth.

Direct Effects of Alternatives A, C and D

Alternatives A, C, and D would thin from below 1,157 acres of developing and existing old-growth; 373 acres of existing old-growth; and 784 acres of developing old-growth, consisting of ponderosa pine and pine-oak habitat. Thinning from below will improve the health and growth of the old-growth tree component and long-term health of the stand.

In existing old-growth sites, the thinning from below methods would include:

Thinning from below to a basal area of 40 to 100 ft.^{2} per acre South of Kelly Canyon (37 acres) and Mexican Pocket (46 acres) treatment areas:

- Thinning from below around old trees in the Thinning from Below – Improving Old Tree Longevity and Gambel Oak Habitat (92 acres) treatment areas;
- Thinning from below in the Wildlife Movement Corridor (98 acres) treatment areas; and
- Thinning from below trees no greater than 9 inches in diameter in the Thinning from Below – Mexican Spotted Owl Protected Activity Centers (100 acres) treatment sites.

Thinning from below in developing old-growth sites includes:

- South of Kelly Canyon (324 acres) treatment areas;
- Mexican Pocket (67 acres) treatment areas;
- Improving Old Tree Longevity and Gambel Oak Habitat (176 acres) treatment areas;
- Dense Canopy Retention for Improving Forest Resiliency of Goshawk Habitat (82 acres) treatment area; and
- Mexican Spotted Owl Protected Activity Centers (135 acres) treatment sites.

All existing old-growth trees would be maintained across all action alternatives. There are some 18-inch, black-barked trees that would be removed under Alternative A, but the removal of those trees would not affect old-growth designation of sites. (See Figure 26.)

There would be various densities in the forest landscape with the different thinning prescriptions. This is desirable for wildlife and would help diversify species across the project area. Some species such as brown creeper and northern goshawk would benefit from denser ponderosa pine old-growth habitat, and other species such as flammulated owl would benefit from open, park-like ponderosa pine old-growth.

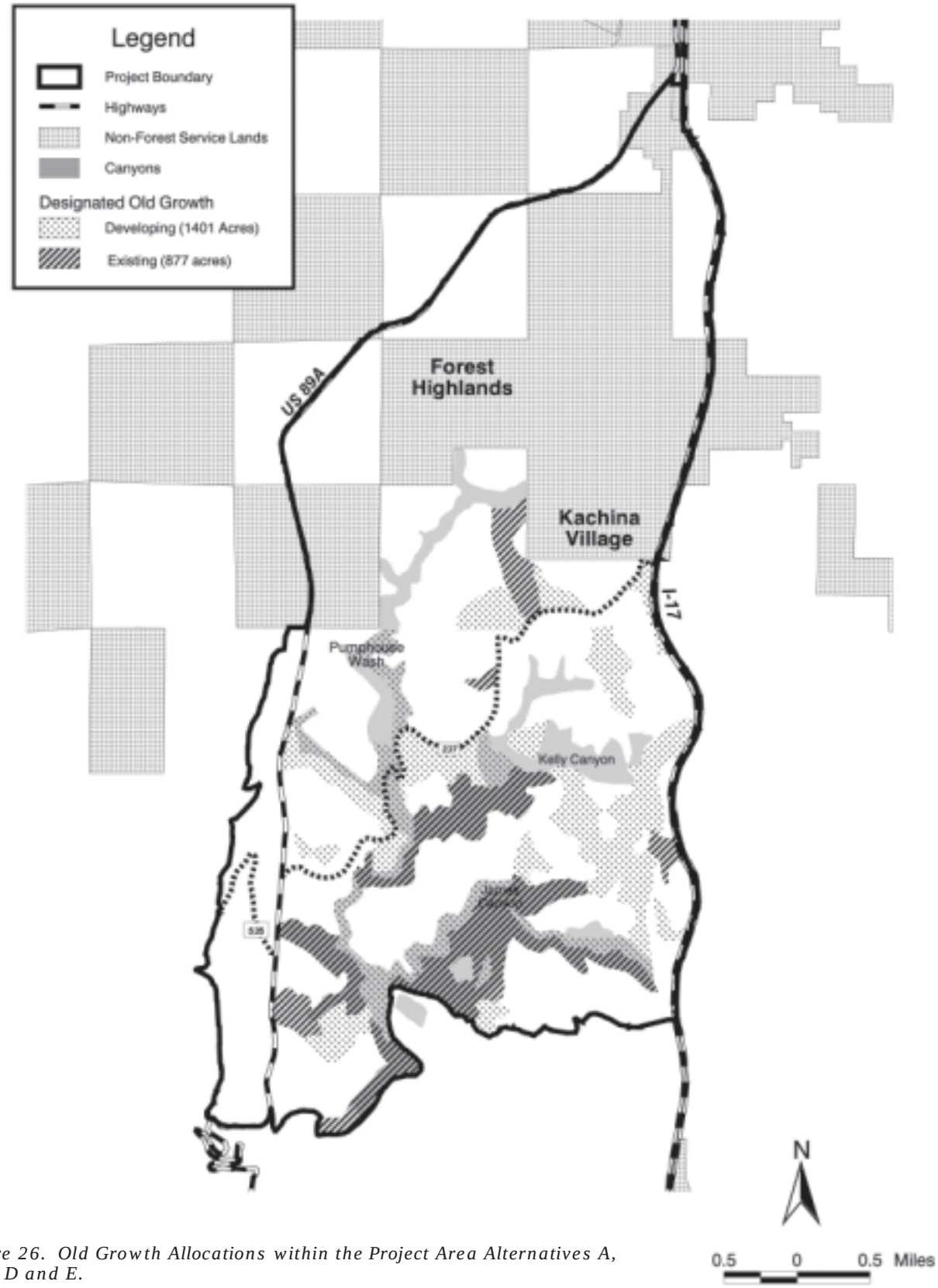

Figure 26. Old Growth Allocations within the Project Area Alternatives A, B, C, D and E.

Direct Effects of Alternative E

Under Alternative E 1,157 acres of developing and existing old-growth would be thinned from below: 373 acres of existing old-growth and 784 acres of developing old-growth, consisting of ponderosa pine and pine-oak habitat. The thinning that would occur will help improve the health and growth of the old-growth tree component and long-term health of stands, although not to the extent as the other action alternatives. Under Alternative E there is a 9-inch diameter limit on 737 acres of existing (184 acres) and developing (553 acres) old-growth stands. Trees on these sites would have slower growth rates, and the canopy would be denser compared to other action alternatives. Old-growth trees on these sites would be more susceptible to mortality due to competition, insect infestation and diseases.

Thinning from below treatments in old-growth sites under Alternative E include:

- Intensive thinning to 50 basal area in a zone extending 660 feet out from private property boundaries (43 acres);
- Variable thinning to 60 to 120 basal area with a 16-inch diameter limit north of Kelly Canyon outside the private property intensive zone (377 acres);
- Thinning with a 9-inch diameter limit in north of Kelly Canyon where there are no roads (28 acres); and
- South of Kelly Canyon with a 9-inch diameter limit (709 acres).

Under Alternative E, three sites designated as old-growth, existing or developing, fall into the 660-foot wildland-urban interface zone, which is the zone of intensive treatment. These are sites 336/11 (existing old-growth), 336/12 (developing old-growth) and 345/1 (developing old-growth). Removal of trees within this “Intensive Zone” would not change the designation of these sites as old-growth. In the intensive treatment zone, more of the smaller diameter size trees would be removed, leaving the larger trees. Under Alternative E, the post-treatment designation of old-growth sites inside and outside the 660-foot wildland-urban interface zone would not differ from all other alternatives.

North of Kelly Canyon for Alternative E, effects would be the same as Alternative C where no trees greater than 16-inches diameter are cut. South of Kelly Canyon has a 9-inch diameter limit for this alternative, and old-growth stands south of Kelly Canyon would remain dense. Wildlife species distributions would differ from other action alternatives due to the dual forest structure pattern under this alternative. North of Kelly Canyon would favor species that require more open old-growth stands such as flammulated owl. Stands south of Kelly Canyon would favor species that benefit from denser old-growth stands such as brown creeper.

The high fire hazard potential would persist under Alternative E for old-growth stands south of Kelly Canyon. In the event of a large wildfire, old-growth sites would be compromised and trees would be lost, thus affecting form and function of old-growth.

Indirect Effects of Alternatives A, C, and D

Modeling was completed for all action alternatives comparing several thinning from below scenarios and tree size in 50 years (PRD 130). In 50 years, tree growth rate is greatest with the thinning to 50 basal area scenario, followed by the thinning to 80 basal area. The thinning with a 9-inch diameter limit showed slightly greater growth in trees compared to the no thin scenario, yet these two scenarios are similar to each other with both showing the slowest growth rates at 50 years with no other thinning activities.

There is relatively no difference between Alternative A (Proposed Action), C (16-inch diameter limit), and D (18-inch diameter limit) in regard to future old-growth recruitment. Alternatives A, C, and D would show the greatest recruitment for old-growth of trees into the VSS 5 and 6 classes in 50 years. These alternatives would thin out trees and reduce dense canopies compared to Alternatives B and E, therefore reducing the risk of loosing old-growth trees due to biological stresses or a crown wildfire event. Alternatives A, C, and D would promote development of old-growth habitat (see VSS tables above). Thinning improves health and vigor of trees and improves the likelihood of stands reaching old-growth condition; trees would grow larger more quickly. In 50 years post-treatment under Alternatives A, C, and D, there would be an increase of approximately 175 to 180 percent in the VSS 5 class and a 50 percent increase in the VSS 6 class.

Indirect Effects of Alternative E

Under Alternative E trees would have smaller diameters, on average, compared to trees under the other action alternatives, and trees would have slower growth rates. With limited treatment in sites where trees less than 9-inches diameter are cut, old-growth recruitment areas would decline in health and vigor, and some may never reach old-growth condition due to dense stand conditions.

Dense stand conditions increase susceptibility to insect infestation and diseases, and increase risk from crown wildfire. The high fire hazard potential would persist under Alternative E for old-growth stands south of Kelly Canyon. In the event of a large wildfire, old-growth sites would be compromised and trees would be lost, thus affecting form and function of old-growth. In 50 years post-treatment, there would be little recruitment to old-growth condition with an increase of 18 percent in the VSS 5 class and no recruitment into the VSS 6 class.

Indirect Effects of Alternative B

Under Alternative B (No Action), there would be no immediate change to old-growth trees or old-growth stands. Under Alternative B the dense nature of the forest would persist, thus trees are susceptible to higher mortality rates due to competition, insect infestations and diseases, and the forest is at risk of a large wildfire event. Modeling shows that old-growth habitats primarily within Mexican spotted owl PAC's 040214, 040509, and 040539 and the wildlife movement corridor are at most risk from a wildfire (PRD 73).

Under Alternative B, old-growth tree mortality would occur at a greater rate than in thinned stands due to biological stresses such as competition, insect infestation and diseases (PRD 130; see document 112 in the project record for the Fort Valley Ecosystem Restoration Project). Without treatment, many old-growth recruitment areas would decline in health and vigor, and some may never reach old-growth condition due to current dense stand conditions that increase susceptibility to insect infestation and diseases, and increase risk from crown wildfire. This alternative would show greater tree mortality rates. If a wildfire event occurred, the result would be loss of old-growth trees and old-growth blocks, as 95 percent of developing and existing old-growth sites have expected fire behavior rated as high to extreme (PRD 73). In 50 years there would be no recruitment into the VSS 5 and 6 classes.

Cumulative Effects of Alternatives A, C and D

Past silvicultural practices targeted the harvesting of large trees and suppression of fires. This in effect created conditions we have today: small sized trees comprising the vast majority of the landscape (VSS 3), and a paucity of large, old trees that would be recruitment old-growth and the old-growth component (VSS 5 and 6).

Old-growth analysis in the long term was addressed at multiple scales during the analysis phase. Old-growth allocations to the west (Crater Sinks 10K and Woody Ridge 10K), south (Ritter 10K), and east (Newman 10K) were considered. North of the project area, City of Flagstaff, did not offer flow and connectivity of old-growth. Old-growth allocations in the Kachina Village FHP area tie to those associated with Fry Canyon (Crater Sinks 10K), Woody Ridge (Crater Sinks 10K), the Wilson Seep drainage system that connects to Pumphouse Wash (Ritter 10K), the Mortgage Spring drainage system that connects to James Canyon (Ritter 10K), and James Canyon and its tributaries east of I-17 (Newman 10K) (Figure 27).

In the Kachina Village FHP, existing old-growth trees are maintained and add to the presence of existing old-growth trees in the surrounding landscape. Developing old-growth areas are enhanced, and will add to the overall amount of old-growth on the landscape when combined with the project areas described above. The amount of national forest land managed for old-growth is 29.3 percent, exceeding the Forest Plan guideline of a minimum of 20 percent.

Cumulative Effects of Alternative E

Old-growth will develop more slowly than under Alternatives A, C, and D and, therefore, the addition of old-growth with old-growth in the surrounding landscape occurs more slowly. Potential loss from wildfire is higher than Alternatives A, C, and D and lower than B. Loss of old-growth from high intensity crown fire would subtract from the total amount of old-growth in the surrounding landscape. The designation of old-growth areas is the same as Alternatives A, C, and D.

Cumulative Effects of Alternative B

There would be less old-growth over time as some trees are unable to develop into old-growth due to dense stand conditions. Tree mortality will be higher. These factors combine to provide less old-

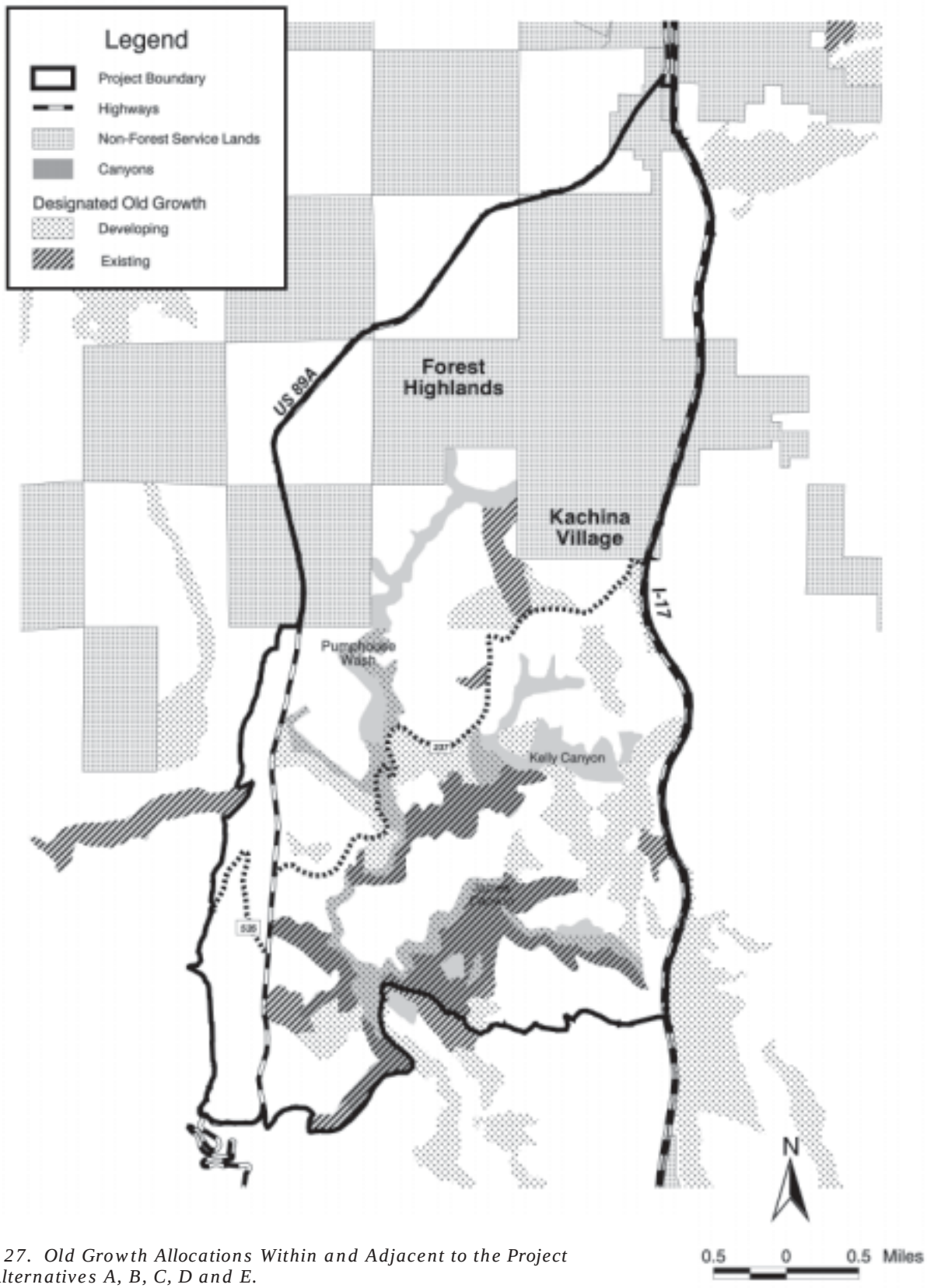

Figure 27. Old Growth Allocations Within and Adjacent to the Project Area Alternatives A, B, C, D and E.

growth trees to add to the surrounding landscape. The designation of old-growth areas is the same as Alternatives A, C, D, and E. The potential for loss of old-growth to high intensity crown fire is high in this alternative; this would subtract from the total amount of old-growth in the surrounding landscape. (See Figure 27.)

Threatened, Endangered, and Sensitive Species

A narrative for the project area of the evaluation of the threatened, endangered and sensitive species that occur on the Mormon Lake Ranger District is located in the project record (PRD 123). Four species are evaluated in the biological assessment and evaluation (BA&E) regarding the preferred alternative for the project, as these species occur or there is suitable habitat in the project area and there are possible affects. These species are American peregrine falcon, northern goshawk, Flagstaff beardtongue, and Flagstaff pennyroyal.

Consultation with the USDI Fish and Wildlife Service (USFWS) regarding threatened and endangered species in the project area has already occurred under the Wildland-Urban Interface Batch-Programmatic Environmental Assessment and Evaluation for several projects in the Southwestern Region (USDA Forest Service 2001a). A biological opinion was issued by the USFWS in April 2001 (USDI Fish and Wildlife Service 2001). Eight species found within or near the project area, currently or historically, were included in the analyses. The USFWS made determinations for species potentially affected by activities within the Kachina Village FHP area. They are shown in Table 21.

Black-footed ferret and jaguar occurred historically in the project area according to the USFWS. Currently there are no black-footed ferrets or suitable habitat within the Kachina Village FHP area. The jaguar is extirpated from the area. Gila trout occurred historically in Oak Creek, downstream from the project area.

There are no bald eagle nesting areas or known winter roost areas in the project area; however, there is one bald eagle potential winter roost area. There are two Mexican spotted owl PAC's that occur within the project area and two that extend into the project area. Critical habitat for the loach minnow, razorback sucker, and spikedace occurs in Oak Creek and the Verde River downstream from the Kachina Village FHP, with the watershed of these streams in the project area. These five species are discussed below.

Sensitive Species Analyzed

- Navajo Mountain Mexican vole, *Microtus mexicanus navaho*
- American peregrine falcon, *Falco peregrinus anatum*
- Northern goshawk, *Accipiter gentilis*
- Flagstaff beardtongue, *Penstemon nudiflorus*
- Flagstaff pennyroyal, *Hedeoma diffusum*

Table 21. Threatened, Endangered or Sensitive Species Potentially Affected by Activities

Species	Determination
Black-footed ferret, *Mustela nigripes*	No effect; no critical habitat
Jaguar, *Panthera onca arizonensis*	No effect; no critical habitat
Bald eagle, *Haliaeetus leucocephalus*	May affect, not likely to adversely affect; no critical habitat
Mexican spotted owl, *Strix occidentalis lucida*	May adversely affect; no critical habitat
Gila trout, *Onchorhynchus gilae gilae*	No effect; no critical habitat
Loach minnow, *Tiaroga cobitis*	No effect to the species; critical habitat call is may affect, not likely to adversely affect
Razorback sucker, *Xyrauchen taxanus*	May affect, not likely to adversely affect; critical habitat call is may affect, not likely to adversely affect
Spikedace, *Meda fulgida*	May affect, not likely to adversely affect; critical habitat call is may affect, not likely to adversely affect

- Spotted skipperling, *Piruna polingii*
- Mountain silverspot butterfly, *Speyeria nokomis nitocris*
- Blue-black silverspot butterfly, *Speyeria nokomis nokomis*

Bald Eagle, *Haliaeetus leucocephalus* (Threatened)

Affected Environment

There is one bald eagle potential winter roost site approximately 34 acres in size south of Kelly Canyon. Wintering bald eagles occur in the project area, primarily along Interstate 17, which is the eastern boundary of the project area. Bald eagles feed on road-killed animals along the highway. They forage on animal carcasses forest-wide, and prey on waterfowl and fish at lakes and tanks that support these prey species. At night, small groups (usually 2 to 12) or individual eagles roost in groups of large trees in protected locations such as drainages and hillsides. Roost sites are ponderosa pine groups of large trees (average size of 28.3 inches in diameter and 93 feet tall), 5 to 40 acres in size (old-growth groups 5 to 10 trees per acre), on slopes of 10 to 35 percent, with a canopy closure of 50 to 80 percent, and are near food sources (Dargan 1991).

Consultation with the USFWS has already occurred (USDA Forest Service 2001a) and the determination in the biological opinion for the bald eagle in the Kachina Village FHP and region-wide was “may affect, not likely to adversely affect” (USDI Fish and Wildlife Service 2001). Mitigation measures for known roosting areas will be followed (see Chapter 2, “Project-Specific Mitigation”).

Direct Effects of Alternatives A, B, C, D, and E

Under all action alternatives, proposed mechanical treatments and broadcast burning may cause visual or auditory disturbance to foraging bald eagles. This disturbance would be localized, of short duration and low intensity, and may affect individual birds but would not affect the overall distribution or reproduction of the species.

Under all alternatives, recreation would continue along Forest Road (FR) 631 in the vicinity of the potential winter roost site. FR 631 would remain open for approximately 2 miles, and recreation activities are expected to continue at current levels along this stretch of road under all alternatives. The greatest impact currently occurs along the first mile of FR 631 and the potential winter roost site is located along this stretch. Impacts to individual birds may occur from recreation activities between October 15 and April 15 because this site is in close proximity to the Kelly Canyon interchange on I-17 and this area of the forest may be accessible at times during the winter months, however, throughout much of the winter the area would be inaccessible due to snowpacked roads.

Recreation activities would continue in other areas within the project boundary. Under all action alternatives, recreation activities would be regulated and the number of impact areas would be reduced, therefore providing a benefit to bald eagle. Under Alternative B, recreation activities would continue at current levels. Recreation activities in the project area would not considerably affect the overall distribution, reproduction or winter roosting of the bald eagle as recreation activities are reduced during winter months when bald eagles are present.

There are no direct effects to bald eagles from Alternative B (No Action).

Indirect Effects of Alternatives A, B, C, D, and E

Indirect effects to the bald eagle include affects to eagle habitat, eagle prey species, or prey species habitat. There are no anticipated adverse effects to prey species or prey species habitat.

The main effects are more likely to occur when project treatments modify the number of trees in a group of suitable roost trees, as eagles prefer to roost in large trees within close proximity to other large trees.

Thinning would improve old tree longevity in the potential winter roost site and any other unknown winter roost sites by reducing competition for light, moisture, and nutrients and reducing the risk of insect infestation and disease. Under Alternative A there would be recruitment of trees into developing and existing old-growth stands, which may be used as future winter roost sites for bald eagles.

Although treatment prescriptions call for retaining large trees, Alternative A may thin approximately 2.8 black-barked, 18-inch diameter trees per acre from site 345/34, of which approximately the southern and southwestern 12 acres is part of the potential winter roost site. Some black-barked, 18-inch diameter trees would be removed from the northeastern portion of the potential winter roost site. This may reduce the quality of roosting potential for

this portion—35 percent of the potential winter roost site—by possibly reducing canopy closure to less than or equal to 45 percent in the 12-acre portion. The remaining 22 acres of the potential winter roost site would not be affected. Site 345/34 is designated as existing old-growth, and the designation would not be affected by the removal of less than or equal to 2.8 black-barked, 18-inch diameter trees. (See Chapter 2, "Wildlife and Sensitive Species Habitat Protection" for mitigation measures regarding the bald eagle.)

Under Alternatives C and D, canopy closure would remain within the limits of the preferred 50 to 80 percent. There would be no adverse indirect effects to the potential bald eagle roost site or any other unknown roost sites. Under Alternatives C and D there would be recruitment of trees into developing and existing old-growth stands, which may be used as future winter roost sites for bald eagles.

Under Alternative E all trees 9 inches in diameter and larger would be retained in roughly the southern half of the project area. The potential winter roost site would not be adversely affected under Alternative E from thinning activities. However, under Alternative E tree density would remain high and the adverse effects to trees from competition coupled with the continued risk of insect infestation and disease would persist. Under Alternative E there would be very little or no recruitment of trees into developing or existing old-growth, thus there would be relatively no benefit to wintering bald eagles. Additionally, the high fire hazard potential south of Kelly Canyon would persist. In the event of a large wildfire, the potential winter roost site and old-growth sites may be destroyed.

Under Alternative B (No Action), there are no treatment effects. However due to the continued high tree density, adverse effects to trees from competition coupled with the continued risk of insect infestation and disease would persist. Alternative B would not promote recruitment of trees into developing or existing old-growth, thus there would be no benefit to wintering bald eagles. Additionally under Alternative B, there is high fire hazard potential in the project area. In the event of a large wildfire, the potential winter roost site, any other unknown roosts, and old-growth sites may be destroyed.

Proposed treatments under all action alternatives would not affect the numbers, distribution or reproduction of the bald eagle, but may at times disturb foraging birds on a short-term basis. Recreation activities under all alternatives would not adversely affect the bald eagle.

Cumulative Effects of Alternatives A, B, C, D, and E

Historical silvicultural practices of removing large sized trees and suppression of fires on national forest and state lands created a forest of existing conditions composed primarily of dense canopy stands of 5 to 12-inch diameter trees. This condition is not beneficial to wintering bald eagles. However, recent past silvicultural practices have created more suitable habitat for the bald eagle by leaving large trees and thinning from below, which enhances tree growth and vigor.

Under the action alternatives, there is no effect to the numbers, distribution or reproduction of the bald eagle so there is no added effect. Recreation management activities and recreation have little affect on wintering bald eagles so there is little added affect. Short-term disturbance to foraging or roosting bald eagles during thinning and broadcast burning activities may cause eagles to forage and roost in nearby areas for the duration of the activity.

Short-term smoke impacts can be considered cumulatively with similar impacts in the Pumphouse Multiproduct Timber Sale area and the Airport Fuels Reduction Project Broadcast Burn, however, implementation of these burns are not likely to occur simultaneously and do not combine to cause a negative effect.

Mexican Spotted Owl, *Strix occidentalis lucida* (Threatened)

Affected Environment

There are two Mexican spotted owl protected activity centers (PAC's) that occur within the project area (040509 and 040539) and two that extend into the project area (040214 and 040512). There is one PAC adjacent to the southwest boundary of the project area (040215). Mexican spotted owl habitat typically consists of mixed conifer and/or ponderosa pine-Gambel oak vegetation types in steep canyons, on mountainsides and on ridges. In the Kachina Village FHP, owl PAC's are associated with canyons. Outside of PAC's there are 160 acres of steep slope protected, 2,060 acres of restricted habitat and 219 acres of restricted habitat identified as target/threshold within the project area boundary. The breeding season is from March 1 to August 31.

Surveys done to Forest Service Region 3 protocol were conducted within the project boundary and 1/2 mile outside the project boundary in 2000 with positive results. Owls were located in PAC 040215

(single response), 040509 (pair response), 040512 (pair response), and 040539 (single response). No nests were located. No Mexican spotted owls were located in PAC 040214, and none were located outside PAC's.

PAC's were monitored during 2001 with positive results. Owls were located in PAC 040215 (single response), 040509 (pair response), 040512 (single female response) and 040539 (pair response). No nests were located. No Mexican spotted owls were located in PAC 040214.

Within the project boundary, only two Mexican spotted owl PAC's would be treated. PAC 040509 would have 294 acres and PAC 040539 would have 162 acres thinned from below with trees no greater than 9 inches in diameter removed. These acres would also be broadcast burned along with other acreage outside of the canyons. There is no planned broadcast burning within canyons or within 300 feet of the canyon rims.

Consultation with the USFWS has already occurred (USDA Forest Service 2001a) and the determination in the Biological Opinion for the Mexican spotted owl in the Kachina Village FHP was "may adversely affect" (USDI Fish and Wildlife Service 2001). Furthermore, on a region-wide basis it is the biological opinion of the USFWS that "implementation of the Proposed Action, as necessary to reduce the risk of catastrophic wildfire, is not likely to jeopardize the continued existence of the Mexican spotted owl" (USDI Fish and Wildlife Service 2001, page 101).

Direct Effects of Alternatives A, B, C, D, and E

Under all action alternatives there would be no direct effects from thinning from below activities as the canyons, where spotted owls are primarily found, are deferred from treatment.

Under all action alternatives, direct effects to Mexican spotted owl would be from smoke created from broadcast burning. Smoke would tend to settle into the canyons and low-lying areas during nighttime, and could potentially affect spotted owls. Smoke may drift into PAC's from burning that occurs in other portions of the Kachina FHP area. Smoke effects could occur in the spring within the breeding seasons. Smoke effects would be short term. Mexican spotted owls are known to return to PAC's or to areas near PAC's after fires and smoke events have ceased. Short-term impacts from smoke would be reduced by coordination of timing and type of burning with wind direction, topography, time of year, and distance to PAC's. There is no lighting of broadcast fires allowed on acres within PAC's during the breeding season.

There are no direct effects from Alternative B.

Indirect Effects of Alternatives A, B, C, D, and E

Under all action alternatives, there would be minimal effects from thinning and piling in owl habitat as thinning treatments are outside of the canyons away from the activity centers. Treatments in owl habitat will be conducted in compliance with the Recovery Plan (USDI Fish and Wildlife Service 1995) and Forest Plan standards and guidelines. It is estimated there could be up to 20 percent loss of snags and 50 percent loss of downed logs during broadcast burning (Randall-Parker and Miller 1999) although many will be protected using appropriate ignition and piling techniques, and lining of most snags. Microhabitat monitoring will be conducted according to Region 3 Microhabitat Monitoring Protocol. Broadcast burning occurs within a portion of each PAC. Effects to prey species are minimal because snags and logs are maintained in the unburned portion of each PAC.

Under Alternatives A, C, and D the fire hazard potential is reduced. Thinning from below in sites adjacent to owl PAC's, in addition to thinning from below trees no greater than 9-inches diameter in certain sites within owl PAC's, would give added protection to owl habitat from a large wildfire event.

Under Alternative E dense forest conditions would still occur and the high fire hazard potential would persist. Under Alternative B the high fire hazard potential in the project area will persist. A large wildfire event may result in the loss of Mexican spotted owl habitat and possibly individual owls.

Under all action alternatives, road closures and increased management of camping and recreation opportunities would be beneficial to Mexican spotted owl by regulating access and reducing human impacts to owl PAC's and individual owls.

Rehabilitation activities at Kelly Seep will not affect owl habitat.

Cumulative Effects of Alternatives A, B, C, D, and E

The projects in the general area considered for this analysis are those listed in the introduction to this chapter.

Past silvicultural practices targeted the harvesting of large trees and suppression of fires. This, in effect, created conditions we have today that create the high fire hazard potential in the project area.

Under all alternatives there would be no direct effects to Mexican spotted owl PAC's and, therefore, no cumulative effect to other PAC's in the area. Treatments in owl habitat will be conducted in compliance with the Recovery Plan (USDI Fish and Wildlife Service 1995) and Forest Plan standards and guidelines. This results in minimal direct effects and, therefore, no cumulative effect. Broadcast burning occurs within a portion of each PAC. Effects to prey species are minimal because snags and logs are maintained in the unburned portion of each PAC. This effect is additive to similar impacts on the adjacent Airport Fuels Reduction Project (approximately 1,000 acres of broadcast burning). The combined effect is minimal.

Should Mexican spotted owl habitat be lost due to high intensity crown fire, the owl populations in the general area would be affected.

Fishes

Affected Environment

Three threatened and endangered species occur downstream from the Kachina Village FHP area in Oak Creek and Verde River: loach minnow, *Tiaroga cobitis* (threatened), razorback sucker, *Xyrauchen taxanus* (endangered), and spikedace, *Meda fulgida* (threatened). Critical habitat for the loach minnow occurs in Oak Creek and the Verde River over 15 miles downstream from the project. Critical habitat for the razorback sucker occurs in the Verde River 54 miles downstream from the project. Critical habitat for spikedace occurs in Oak Creek and Verde River over 15 miles downstream from the project. Although these fishes do not occur within the project area, the watersheds of Oak Creek and the Verde River do.

Direct Effects of Alternatives A, B, C, D, and E

For all action alternatives there would be no direct effects to these species from project activities.

There are no direct effects from Alternative B.

Indirect Effects of Alternatives A, B, C, D, and E

Indirect effects to fishes would be from the possibility of sedimentation during treatments and re-opening of temporary roads in the project area. Under all action alternatives, Best Management Practices would be implemented (See PRD 137c) and any effects would be minimized.

Under Alternatives A, C, and D there would be minimal effects to fish species habitat, with no adverse effects expected. Any sedimentation that may occur from project activities would be short term with expected soil stabilization and the establishment of an herbaceous vegetation understory. Adequate buffers have been developed on all major drainages. Most sediment will remain in storage rather than move downstream into Oak Creek, with a small portion of anticipated soil loss expected to occur and enter ephemeral stream channels (see soil and water effects section). Road closures would reduce sedimentation loads. Alternatives A, C, and D would reduce the risk of a large wildfire the most, thus the potential risk of sedimentation and affects to fishes downstream from such an event would be reduced.

Under Alternative E effects would be less than the other action alternatives due to less mechanical disturbance in the project area. Road closures would reduce sedimentation loads. Alternative E would not reduce the risk of a large wildfire event due to a continuation of a dense forest canopy. Fire hazard potential would remain high, and with the advent of a large wildfire event, soil sedimentation would occur and may adversely affect fishes downstream of the project area.

Under Alternative B (No Action), there would be no change in soil conditions and no new soil disturbances. There would be no road closures under this alternative, which would continue current sedimentation loads into drainages. This continued level of sedimentation from the existing road system and social roads may have negative effects to fish species habitat in the long term compared to all action alternatives. Under this alternative fire hazard potential would remain high, and with the advent of a large wildfire event, soil sedimentation would be great and may adversely affect fishes downstream of the project area.

Cumulative Effects of Alternatives A, B, C, D, and E

There are no direct effects that would cause a cumulative effect when added to other activities in and around the Kachina FHP. There are no adverse indirect effects expected and, therefore, no cumulative effect.

Should high intensity wildfire occur, then downstream effects could cause impacts to fish and fish habitat. The potential for high intensity wildfire is greatest under Alternative B.

Navajo Mountain Mexican Vole, *Microtus mexicanus Navaho* (Sensitive)

Affected Environment

There are no documented populations or sightings of voles in the project area; however, some suitable habitat exists within the area. Voles occupy meadows and riparian areas above the Mogollon Rim associated with ponderosa pine or other coniferous forests. They also occur within the forested areas where tree densities are low. They rely on grasses and other herbaceous vegetation for food and cover. Suitable habitat within the project area is currently 7 percent of the project area.

Direct Effects of Alternatives A, B, C, D, and E

Direct effects would be similar between Alternatives A, C and D for this species. Disturbance during thinning and broadcast burning activities may occur to individual voles; some individuals may be lost. Burning removes cover and food. Such activities would occur across the project area at different times; therefore, activities would be temporally and spatially separated. Effects would be short term. There would be no effects to population viability of the voles.

Under Alternative E, effects would be similar but to a lesser extent compared to the other action alternatives. Disturbance activities would be reduced. Roughly half of the project area would be thinned similarly to Alternative C, the northern part of the project, where short-term disturbance would be the greatest under this alternative. Roughly the southern half would retain a dense canopy structure due to the 9-inch diameter limit, where short-term disturbance would be the least.

Recreation effects under all action alternatives would be reduced due to establishment of designated camping areas, reduction in disbursed camping sites, and closing social trails. Road closures under all action alternatives would be beneficial to this species. Under all action alternatives, construction of new segments of a trail system and temporary roads may impact the Navajo Mountain Mexican vole due to construction activities and loss of habitat. Areas where trail construction would occur are limited within the project area.

Benefits to the vole would be realized under all action alternatives with regulated recreation activities and road closures. Temporary roads will be closed after treatments are completed, and in time voles could use these areas.

There would be no disturbance under Alternative B. Currently 62 percent of the project area is in dense conditions. Dense forest stands provide low quality habitat for the Navajo Mountain Mexican vole. Recreation activities would not change under this alternative, and no road closures would occur. Activities from recreation and road travel at current levels would continue to pose an adverse affect to voles due to soil and vegetation disturbance and soil compaction.

Indirect Effects of Alternatives A, B, C, D, and E

Benefits to voles would occur due to the reduction of the dense forest canopy and increased growth in herbaceous vegetation on the forest floor project-wide for all action alternatives, although Alternative E would have a lesser positive effect compared to the other action alternatives. Alternative E would be less beneficial to the vole due to the continuance of a dense canopy overall. Grassy openings and meadows and open canopy areas would increase by approximately 400 percent under Alternatives A and D, increase by 357 percent under Alternative C, and increase 79 percent under Alternative E. Alternative B will continue to limit habitat for this species.

The high fire hazard potential would persist under Alternatives B and E, and a large wildfire event would have the potential to affect many individuals.

In 20 years post-treatment compared to current existing habitat of 7 percent, grassy openings and meadows and open canopy areas would decrease by approximately 36 percent under Alternatives A, C and D, decrease by 43 percent under Alternative E, and decrease by 50 percent under Alternative B.

In 50 years post-treatment, with no further treatments and compared to current existing habitat of 7 percent, grassy openings and meadows and open canopy areas would decrease by approximately 93 percent under all alternatives.

Cumulative Effects of Alternatives A, B, C, D, and E

Past silvicultural practices targeted the harvesting of large trees and suppression of fires. This in effect created the dense forest condition we have today in

the project area that is unfavorable to Navajo Mountain Mexican vole.

Projects reviewed for this discussion are those listed at the beginning of this chapter.

Direct effects of disturbance during implementation of thinning, broadcast burning and recreation trailhead and trail construction activities are additive to similar disturbances in other projects. The timing of implementation is such that all projects will not occur simultaneously. Adverse cumulative effects are not expected.

The direct effect of improved habitat due to recreation and road management activities adds to similar improvements in the Griffiths Spring area and the Fort Tuthill to Kachina Trail area.

The indirect effects of lower canopy closure and the beneficial increase in understory vegetation adds to the same effects in the Pumphouse Multiproduct Timber Sale area, the Airport Fuels Reduction broadcast burn, thinning on State Section 26, and the Oak Creek Fuels Reduction Project.

Infill of private land has the greatest potential impact to vole habitat. There are no undeveloped parcels of private land in the project area.

American Peregrine Falcon, *Falco peregrinus anatum* (Sensitive)

Affected Environment

Peregrine falcons occur statewide as migrant, transient, and/or wintering individuals. The subspecies *anatum* breeds on selected isolated cliff ledges and is a permanent resident on the Coconino National Forest. The peregrine breeding season is from March 1 to August 31. Peregrine falcons do not typically hunt within forested stands but are aerial predators. Peregrines prey mainly on birds found in wetlands, riparian areas, open areas, canyons, and mountain slopes within a 10 to 20-mile radius from the nest site. Prey items also include bats and mammals. The peregrine falcon was removed from the Federal List of Endangered and Threatened Wildlife in August 1999 (USDI Fish and Wildlife Service 1999) and is now a Forest Service Sensitive species.

There is one known breeding area associated with the project. Falcons are known to occupy this site; nesting status is unknown. There is other potential habitat within the project area.

Direct Effects of Alternatives A, B, C, D, and E

Falcon nesting habitat is located in Pumphouse Wash within 1/4 mile of sites selected for treatment. Under all action alternatives there is potential for disturbance during treatments, therefore, timing restrictions during the breeding season would be implemented to avoid potential negative effects to falcons (see Chapter 2, “Wildlife and Sensitive Species Habitat Protection”).

Under Alternative B (No Action), there would be no direct effects.

Indirect Effects of Alternatives A, B, C, D, and E

Under Alternatives A, C, and D the forest would be opened up and provide better sight distances for hunting, therefore benefiting falcons. Prey species base may shift to species that favor more open habitats than currently exist due to a change in forest structure.

Alternative E would open the forest to a lesser extent compared to other action alternatives. Prey species would continue to be present, with species favoring more dense forests. There would be minimal improvement of sight distances for hunting.

There would be no change to the prey species base under Alternative B, and no change in falcon hunting patterns associated with forest structure. This is not a negative effect.

Under Alternatives B and E high fire hazard potential would persist. With the advent of a large wildfire, falcons may be adversely affected. Smoke from fires would settle into the canyon during nighttime, although this would be short term. Additionally, there would be the possibility that spotting from a wildfire may occur and cause a fire to start in the canyon near falcons. Under this scenario, prey species habitat may be destroyed and individual falcons may be harmed. However, population viability would not be affected because there is only one eyrie in the project area.

Cumulative Effects of Alternatives A, B, C, D, and E

Past silvicultural practices targeted the harvesting of large trees and suppression of fires. This, in effect, created the dense forest condition we have today in the project area. A shift in prey base species that favor dense forest conditions would have occurred. This does not contribute to a cumulative effect to peregrine falcon.

Potential negative direct effects are mitigated with timing restrictions on implementation of activities in the vicinity of nesting habitat; therefore, there is no added effect when considered with other projects in and surrounding the Kachina FHP.

The beneficial indirect effect of increased sight distances for hunting is additive to similar effects where they occur in the Pumphouse Multiproduct Timber Sale and the Oak Creek Canyon Fuels Reduction Project.

Northern Goshawk, *Accipiter gentilis*

Affected Environment

The principle forest types occupied by northern goshawk in the Southwest are ponderosa pine, mixed species, and spruce-fir. The goshawk is a forest habitat generalist that uses a wide variety of forest stages. Three components of a goshawk's nesting home range are identified as nest area, post-fledging family area, and foraging area. It prefers stands of intermediate canopy cover for nesting, while more open areas are used for foraging.

The northern goshawk is opportunistic and a generalist, not relying on one certain prey item or habitat type for foraging. There are over 50 vertebrate species known in the diets of nesting northern goshawks from various locations in North America (Reynolds et al. 1992). Seventeen species are highlighted as selected prey of the northern goshawk (Reynolds et al. 1992). The species most frequently taken by northern goshawk in Arizona and New Mexico are cottontail rabbit, pigeon, golden-mantled ground squirrel, northern flicker, American robin, Abert squirrel, and least chipmunk. It is anticipated that with some places becoming more open and others remaining dense under action alternatives, prey diversity will increase. More open areas will result in increased populations of cottontail rabbit, robins, mourning doves, golden-mantled ground squirrels, and chipmunks.

Only one northern goshawk post-fledging family area (PFA) (040515) is located within the project boundary, and one PFA is adjacent to the northeast edge of the project boundary (040507). The remainder of the project area is foraging habitat for northern goshawk. The project area and 1/2 mile beyond the boundary were surveyed for northern goshawks in year 2000 according to Forest Service Region 3 protocol. No goshawks were found during that survey period.

PFA 040515 was established about 1992 shortly after the publication of "Management Recommendations for the Northern Goshawk in the Southwestern United States" (Reynolds et al. 1992) and prior to the "Record of Decision for Amendment of Forest Plans" (Forest Plan Amendment 11, 1996). The PFA was established based on a number of sightings of goshawks in the general area between 1989 and 1992, and a large unoccupied stick nest was located in 1992. Nest searches conducted in 1992 yielded negative results. Monitoring during the nesting and fledgling period in 1993 likewise yielded negative results. Surveys were conducted in 1991, 1992 and 2000 according to regional protocol with negative results. A revisit to the stick nest in 2001 indicated that the stick nest was no longer in existence and no goshawks were seen or heard within the PFA during this visit. However, there were goshawk sightings within the project boundary during the summer of 2001.

The Forest Plan calls for the establishment of a PFA for known nest sites, old nest sites, areas where historical data indicates goshawks have nested there in the past and where goshawks have been repeatedly sighted over a 2-year or greater time period. Nests were located but confirmed nesting of goshawks has not been documented for PFA 040515, nor have goshawks been sighted for at least 2 consecutive years in the same area. Even in view of these facts, there is a lack of information for years 1994 through 1999. Year 2000 was a drought year and year 2001 indicated nesting of goshawks on the forest was limited, proving to hinder verification of nesting in this PFA. Therefore, we have decided to continue analysis of this PFA.

PFA 040515 overlaps Mexican spotted owl PAC 040539, and the spotted owl standards and guidelines will take precedence over the northern goshawk standards and guidelines in overlapping sites. Conformance with the Mexican spotted owl standards and guidelines and the northern goshawk standards and guidelines will not adversely affect other threatened, endangered, or sensitive species, and does not conflict with other established recovery plans or conservation agreements.

The Forest Plan standards and guidelines state that the general desired distribution across vegetative structural stage (VSS) classes, within and outside PFA's, is 10 percent, 10 percent, 20 percent, 20 percent, 20 percent and 20 percent for VSS 1 through 6 consecutively. Northern goshawk use of grassy openings is well documented in the Manage-

ment Recommendations in the Southwestern U.S. for the Northern Goshawk (Reynolds et al. 1992). Desired canopy cover in ponderosa pine habitat outside PFA's, per Forest Plan standards and guidelines, is 40+ percent on average for VSS 4 through VSS 6 classes. Desired canopy cover in ponderosa pine habitat within PFA's is, on average, 50+ percent (2/3) and 60+ percent (1/3) for VSS 4 class and 50+ percent for VSS 5 and 6 classes. Stands preferred for nesting habitat are in VSS 5B through 6 classes (Reynolds et al. 1992). An "A" canopy is <40 percent cover, "B" is 40 to 60 percent cover and "C" is >60 percent cover. There are somewhat different standards for mixed conifer habitat, however mixed conifer habitat is deferred from treatment within the project area and will not be analyzed herein. The Forest Plan standards and guidelines for canopy cover and the northern goshawk apply to VSS 4, 5, and 6 classes only.

Proposed treatments within the PFA, 614 acres in size, would occur in 5 of the 13 sites. Approximately 304 acres would be treated within the PFA. Only one of the VSS 4 sites would be treated. There are no VSS 5 or 6 sites within the PFA. Sites with nesting stands are deferred from treatment. Human activities in or near nest stands will be limited during the breeding season, March 1 through September 30, so that goshawk reproductive success is not negatively affected.

Direct Effects of Alternatives A, B, C, D, and E

Under all action alternatives, smoke effects from broadcast burning may disturb individual birds, although this would be short term and would not adversely affect goshawks. Timing of broadcast burning may reduce any smoke impacts.

It is estimated there may be up to 20 percent loss of snags and 50 percent loss of downed logs during broadcast burning (Randall-Parker and Miller 1999) although many will be protected using appropriate ignition and piling techniques, and lining of most snags. In addition, a small number of snags may be created from experimental efforts to create snags under Alternatives A and D.

There are no direct effects under Alternative B, No Action.

Indirect Effects of Alternatives A, B, C, D, and E

Reduction of snags and logs would have a negative impact on numbers of prey items, thus prey availability, for northern goshawk. The impact of this effect is expected to lessen in the short term as snags fall and become logs. The number of snags would continue to be in short supply, due to a current shortage of snags. Number of snags is expected to increase in the future as other trees grow, age, and die.

Vegetative Structural Stage (VSS)

Outside the PFA Alternatives A and D would alter the VSS class distribution, changing the forest project area from one dominated by VSS 3 more toward the desired condition, although still lacking the desired condition (Table 22). Because the majority of the forest within the project boundary is within the VSS 3 class, modifications to current sites would cause the sites to fall primarily into the VSS 4 class. Some openings (VSS 1) would be created. Some stands would be converted into the VSS 5 class. Post-treatment effects would be an overabundance of VSS 3 and VSS 4, and a shortage in the remaining VSS classes. The post-treatment lack of sites in the VSS 5 and 6 classes is due to a current lack of sites in these classes. However, over time trees in the VSS 4 class would grow and shift into the VSS 5 class, and later age into the VSS 6 class (see Tables 19 and 20, depicting VSS in 20 years and in 50 years).

Under Alternatives A and D, the PFA would remain dominated by VSS 3 class (Table 23). Treatments would modify some of the sites from VSS 3 class to VSS 4 class. Some openings (VSS 1) would also be created. Post-treatment effects would be an overabundance of VSS 2 through 4, and shortages of VSS 1, VSS 5, and VSS 6 classes within the northern goshawk PFA. The shortages of VSS 1, 5, and 6 classes are due to current conditions lacking such sites.

Alternative C would be very similar to Alternatives A and D, with the only difference that fewer grassy openings (VSS 1) would be created. The effects analysis is the same as under Alternatives A and D.

Under Alternatives A, C, and D forest conditions conducive to goshawk nesting would be improved, although there would continue to be a lack of appropriate nesting stands. Improvement would be short term and long term due to increasing number of tree stands shifting into the VSS 5 and 6 classes. Northern goshawks are expected to continue to forage in the project area. Thinning would increase vigor and growth of remaining trees. Understory herbaceous vegetation would be enhanced from a

more open forest canopy, as sunlight and moisture would be more available. Understory herbaceous vegetation would also be enhanced from broadcast burning as a result of nutrient cycling. These last effects benefit prey species that inhabit more open areas, thus benefit goshawks. Prey species that inhabit denser forests would still be available to northern goshawk. The increase in prey species diversity is very beneficial to northern goshawk; for example, when environmental conditions oscillate, different species of prey will be more abundant, always offering a food resource to northern goshawk. Under Alternatives A, C, and D there would be a reduction in fire hazard potential, thus a reduction in the risk of habitat loss. Treatments would aid the development of recruitment PFA's.

Alternative E would alter the VSS class distribution outside the PFA from a forest dominated by VSS 3 to one dominated more by VSS 4 (Table 22). There would be no change within the goshawk PFA (Table 23). Because the majority of the forest outside the PFA is within the VSS 3 class, modifications to current sites would cause the sites to fall primarily into the VSS 4 class. A few stands would be converted into the VSS 5 class, and very few openings

Table 22. Existing VSS Class Percentages of Total Project Area Acreage, Anticipated Post-treatment VSS for All Action Alternatives, and General Desired VSS Condition outside the PFA.

GENERAL (Does not include PFA)										
	Existing Conditions Alternative B		**Alternatives A and D**		**Alternative C**		**Alternative E**		**Recommended Standards**	
VSS*	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
1	42	0.6	401	5.5	221	3	86	1	710	10
2	267	4	166	2.5	166	2	166	2	710	10
3	4,412	62	1,711	24	1,711	24	2,756	39	1,420	20
4	1,720	24	3,854	54	4,033	57	3,218	45	1,420	20
5	449	6.4	758	11	759	11	662	9	1,420	20
6	210	3	210	3	210	3	210	3	1,420	20

* VSS classes 1=unstocked opening, 2=<5 inches diameter at breast height (dbh) (4.5 feet); 3=5 to 11.9 inches dbh; 4=12 to 17.9 inches dbh; 5=18+ inches dbh; and 6=old-growth.

Table 23. Existing VSS Class Percentages of Total Project Area Acreage, Anticipated Post-treatment VSS for All Action Alternatives, and General Desired VSS Condition within the PFA.

PFA										
	Existing Conditions Alternative B		**Alternatives A and D**		**Alternative C**		**Alternative E**		**Recommended Standards**	
VSS*	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
1	0	0	30	5	15	3	0	0	61.4	10
2	118	19	118	19	118	19	118	19	61.4	10
3	349	57	278	45	287	47	349	57	122.8	20
4	147	24	188	31	193	31	147	24	122.8	20
5	0	0	0	0	0	0	0	0	122.8	20
6	0	0	0	0	0	0	0	0	122.8	20

* VSS classes 1=unstocked opening, 2=<5 inches diameter at breast height (dbh) (4.5 feet); 3=5 to 11.9 inches dbh; 4=12 to 17.9 inches dbh; 5=18+ inches dbh; and 6=old-growth.

would be created. Post-treatment effects would be an overabundance of VSS 3 and VSS 4, and a shortage in the remaining VSS classes. The post-treatment lack of sites in the VSS 5 and 6 classes is due to a current lack of sites in these classes. Over time a few stands in the VSS 3 and 4 classes would grow and shift into the VSS 4 and 5 classes, respectively, and none would age into the VSS 6 class (see Tables 19 and 20 depicting VSS in 20 years and in 50 years and within PFA in Table 25).

Under Alternative E there would be no improvement in the condition of the PFA. Alternative E treatments would improve habitat conditions conducive for goshawk nesting north of Kelly Canyon outside the urban-interface zone and outside the PFA due to an increase in the VSS 5 class, although there would continue to be a lack of appropriate nesting stands. Little improvement toward nesting habitat would occur south of Kelly Canyon. Northern goshawks are expected to continue to forage in the project area, with prey species diversity increasing north of Kelly Canyon. Thinning would increase vigor and growth of remaining trees, and understory herbaceous vegetation would be enhanced, although not to the extent as the other action alternatives. There would not be a reduction in the high fire hazard potential under Alternative E.

Under all action alternatives, all yellow pine trees will be deferred from treatment and retained across the project area. Yellow pines are important for goshawk nest areas. Thinning from below of smaller trees around yellow pines would occur to improve tree longevity. Under Alternative E thinning around yellow pines may be less than that of the other action alternatives due to a 9-inch diameter limit for many sites. Sites would also be managed in efforts to retain snags, logs and woody debris, which is habitat for prey species.

Under Alternative B, the dense forest canopy would persist and the forest structure would continue to be dominated by VSS 3 class. Over time a few stands would shift into the VSS 4 class (see Tables 19 and 20 depicting VSS in 20 years and in 50 years). There would continue to be a severe lack of nesting stands (VSS 5 and 6 classes). There would be no improvement in habitat conditions for northern goshawk. However, goshawks are expected to continue to forage in the project area.

Under Alternatives B and E, the high fire hazard potential would persist and devastation of goshawk habitat may occur in the event of a large wildfire.

Table 24. Canopy Cover Distribution Outside of the Northern Goshawk PFA.

GENERAL (Does not include PFA)									
	Existing Conditions Alternative B		**Alternatives A and D**		**Alternative C**		**Alternative E**		**Recommended Standards for Ponderosa Pine**
VSS*	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	
4A	170	10	557	42	560	39	318	21	VSS 4 average canopy cover 40+ percent
4B	941	55	737	55	839	58	845	56	
4C	609	35	38	3	38	3	355	23	
Sum	1,720		1,332		1,437		1,518		
5A	185	41	227	33	222	33	235	37	VSS 5 average canopy cover 40+ percent
5B	185	41	387	56	381	56	315	50	
5C	79	18	79	11	79	11	79	13	
Sum	449		693		682		629		
6A	0		0		0	0	0	0	VSS 6 average canopy cover 40+ percent
6B	210	100	210	100	210	100	210	100	
6C	0		0		0	0	0	0	
Sum	210		210		210		210		

* VSS classes: 4=12 to 17.9 inches dbh; 5=18+ inches dbh; and 6=old-growth. A=<40 percent canopy cover, B=40 to 60 percent canopy cover, C=>60 percent canopy cover.

Table 25. Canopy Cover Distribution Within the Northern Goshawk PFA.

	Existing Conditions Alternative B		Alternatives A and D		Alternative C		Alternative E		Recommended Standards for Ponderosa Pine
VSS*	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	
4A	0	0	0	0	0	0	0	0	VSS 4 average canopy cover 60+ percent (1/3) and 50+ percent (2/3)
4B	108	74	100	72	104	73	108	74	
4C	39	26	39	28	39	27	39	26	
Sum	147		139		143		147		
5A	0		0		0		0		VSS 5 average canopy cover 50+ percent
5B	0		0		0		0		
5C	0		0		0		0		
Sum	0		0		0		0		
6A	0		0		0		0		VSS 6 average canopy cover 50+ percent
6B	0		0		0		0		
6C	0		0		0		0		
Sum	0		0		0		0		

* VSS classes: 4=12 to 17.9 inches dbh; 5=18+ inches dbh; and 6=old-growth. A=<40 percent canopy cover, B=40 to 60 percent canopy cover, C=>60 percent canopy cover.

Table 26. Sites within the Northern Goshawk PFA Showing Future Conditions in 20 Years and 50 Years Post-treatment for All Action Alternatives compared to Alternative B, No Action, Kachina Village Forest Health Project, Coconino National Forest, Arizona. Treated stands are shaded.

		Alternative B			Alternatives A & D		Alternative C		Alternative E	
Location	**Site**	**Current**	**20 Yrs.**	**50 Yrs.**	**20 Yrs.**	**50 Yrs.**	**20 Yrs.**	**50 Yrs.**	**20 Yrs.**	**50 Yrs.**
345	12	3C	3C	4C	4B	4C	4B	4C	4B	4C
345	13	3C	3C	3C	4B	5C	4B	5C	4C	4C
345	16	4B	4B	4C	4B	4C	4B	4C	4B	4C
345	17	2C	2C	3C	2C	3C	2C	3C	2C	3C
345	20	3C	3C	3C	4C	4C	4C	4C	4C	4C
345	21	3B	3C	3C	4B	4C	4B	4C	3C	3C
345	22	2C	2C	3C	2C	3C	2C	3C	2C	3C
345	25	3B	3C	3C	3C	3C	3C	3C	3C	3C
345	40	3C	3C	3C	3C	3C	3C	3C	3C	3C
345	41	3B	3B	3C	3B	3C	3B	3C	3B	3C
354	2	4C	4C	4C	4C	4C	4C	4C	4C	4C
354	3	3C	3C	3C	3C	3C	3C	3C	3C	3C
354	35	4B	4C	4C	4B	5C	4B	5C	4C	4C

Canopy Cover Associated with VSS Class

Canopy cover standards would be met under all alternatives outside the PFA (Table 24). Post-treatment canopy cover distribution for VSS 4 within the PFA would show a slight shortage for the 60+ percent class (C canopy cover); the desired condition is 33 percent. This result is attributed to current conditions. There are no sites that are in the VSS 5 and VSS 6 classes within the PFA, therefore, there is an acute lack of optimal nesting stands within the PFA.

In the long term under Alternatives A, C and D, a few sites within the PFA would grow and age into stands that would provide favorable nest stand conditions (Table 25). Alternatives B and E would have slower tree growth and would not offer optimal nest stands (VSS 5B-6) in the future, although Alternative E would show some improvement in tree growth over Alternative B.

Roads and Recreation in Northern Goshawk PFA

Recreation activities within the PFA may hinder goshawk reproduction. Currently there are roads and social trails that allow access to or traverse nesting areas within the PFA. Disturbance in nesting areas during the breeding season may cause goshawks to abandon the nest and possibly abandon future use of the nesting area. Under all action alternatives, social trails through nesting areas would be closed, thus benefiting northern goshawks. Road closures would also benefit northern goshawk by reducing disturbance. Under Alternative B, No Action, closure of social trails and some roads would not occur allowing continued access to nesting stands. Therefore, recreational activities would continue to hinder nesting use of affected stands and may adversely affect northern goshawk.

Cumulative Effects of Alternatives A, B, C, D, and E

Historical silvicultural practices of removing large sized trees and suppression of fires created a forest of existing conditions seen today.

The direct short-term effects of smoke disturbance to individual birds adds to similar effects in the Pumphouse Multiproduct Timber Sale area, the Airport Fuels Reduction Project broadcast burn, the Oak Creek Fuels Reduction Project area and State Section 26 burning. However, because ADEQ regulates burning, it is unlikely that these burns would occur simultaneously or even consecutively. In addition, there is enough unburned landscape surrounding these areas that birds can avoid burn areas, returning when smoke subsides.

The decrease in the number of snags and logs and subsequent impact on numbers of prey items adds to a similar effect in the above-mentioned projects where broadcast burning may occur. The cumulative decrease in snags does not result in significant cumulative effect, because other types of prey are available in all areas.

There is a shift toward the desired distribution of VSS classes and canopy cover. Changes in VSS distribution have occurred slightly in the Pumphouse Multiproduct Timber Sale area. The increase in prey species diversity due to an increase in herbaceous understory is additive to similar effects on the projects mentioned above. When combined, there is a positive trend toward Forest Plan desired conditions.

Improvement to nesting habitat forest conditions (Alternatives A, C, and D only) adds to similar improvements of the Pumphouse Multiproduct Timber Sale where nesting habitat is also improved. The closure of social trails in PFA's offsets the effects of social trails in other areas. The decrease in human disturbance from road and trail management activities offsets human disturbance that may occur in the surrounding landscape. The decrease in human disturbance is additive to similar decreases from trail and parking location in the Griffiths Spring area.

No undeveloped parcels of private land remain in the project area.

Cumulative effects are not expected to result in reduction of population viability or a negative trend for listing this species.

Sensitive Native Plant Species

Two sensitive plant species are included in the analysis herein: Flagstaff beardtongue, *Penstemon nudiflorus* and Flagstaff pennyroyal, *Hedeoma diffusum*.

Affected Environment

Flagstaff beardtongue grows in dry pine forests in north-central Arizona from 4,500 to 7,000 feet, flowering from June to August. It occurs on dry slopes with ponderosa pine in mountainous or hilly regions south of the Grand Canyon, in openings and

often along edges of openings and forested areas. It may occur on light, dry neutral soils in eroded or mountainous areas. It has been documented to occur near Anderson Mesa, Lake Mary, Luke Mountain, Mormon Lake, Stoneman Lake, and along Schnebly Hill Road and Oak Creek. Surveys for this plant species were conducted in 2001. Although there were no populations of this penstemon found during survey efforts, suitable habitat exists within the project area.

Flagstaff pennyroyal, a perennial herb, is restricted to scattered limestone and sandstone outcroppings of relatively undisturbed habitats. Habitat for this species consists of rock pavement, cliffs, limestone and sandstone in the ponderosa pine vegetation type, with canopy coverage from 0 percent to 86 percent, and between 4,500 to 7,000 feet elevation. Flagstaff pennyroyal flowers from May through September. The species is found in many areas on the Mormon Lake Ranger District. Surveys were conducted in 2001 and one population of Flagstaff pennyroyal was found within the project area, however, suitable habitat exists throughout most of the project area.

Direct Effects of Alternatives A, B, C, D, and E

Under all action alternatives, disturbance from mechanical activities and broadcast burning may impact individual plants. Alternative E would have a lesser impact due to fewer mechanical activities south of Kelly Canyon. For both species, spring prescribed burning will cause little damage to individual plants if plants are still dormant. Treatment activities would occur across the project area at different times; activities would be temporally and spatially separated. Effects would be short term. Population viability would not be impacted from treatment activities.

There would be no direct effects under Alternative B, No Action.

Indirect Effects of Alternatives A, B, C, D, and E

Under all action alternatives, the creation of grassy openings and reduction in the dense tree canopy in some areas would be beneficial to both species as both species inhabit more open areas or edges. Nutrient cycling from broadcast burning would be beneficial to plants. Any populations of these sensitive species are expected to rebound quickly following broadcast burning, and become larger and more robust with less litter and shade and increased availability of nutrients.

Under Alternative B, distribution of these plant species will be limited due to the dense nature of the forest in the project area. These species thrive in more open habitat conditions than currently exist.

Under Alternatives B and E the high fire hazard potential will persist. With the advent of a large wildfire, plant species would be impacted and populations may be lost due to large expanses of the forest burning at one time and areas would burn hot. Hot fires kill beneficial mycorrhizae in the soil (DeBano 1990, Wright 1996) and volatilize nutrients (Covington and Sackett 1984, 1990; DeBano 1990). Any nutrients that remain in ash may be lost due to erosion. Plants eliminated due to a large, hot-burning wildfire may take years to re-establish. Prescribed fires, which are low intensity fires, typically burn cooler than wildfires (DeBano 1990).

Recreation activities may impact plant species by crushing, trampling and dislodging plants. Impacts occur from hiking and biking due to creation of social trails through habitat and recreational activities such as rock climbing within habitat for these plant species. Off-road driving may crush plants. Under all action alternatives, management of recreation activities by closing social trails and roads would reduce impacts to sensitive plant species. The population of Flagstaff pennyroyal found during survey efforts is located at an access point to James Canyon where a social trail traverses this area. The road leading to this point would also be closed under all action alternatives, thus limiting access to this point and protecting the population. Under Alternative B, individual plants and plant populations of these sensitive species would continue to be at risk from limited favorable habitat and recreation activities.

Cumulative Effects of Alternatives A, B, C, D, and E

Past silvicultural practices targeted the harvesting of large trees and suppression of fires. This, in effect, created the dense forest condition we have today in the project area that is unfavorable to these sensitive plant species that favor more open habitats.

Impacts to individual plants from implementation of thinning, broadcast burning and trail and trailhead construction is additive to similar effects in similar projects in and surrounding the Kachina FHP. However, project design includes avoiding known plant populations where possible, so this cumulative effect is not great. No undeveloped parcels of private land occur in the project area. Flagstaff beardtongue may have an additional cumulative effect

from reseeding efforts along highways and roadways. Like most penstemons, *P. nudiflorus* hybridizes easily. Seed mixes containing other penstemon species, like *P. strictus*, threaten this species genetically.

Plant response to broadcast burning (larger and more robust) is additive to similar effects that have or may occur in the Pumphouse Multiproduct Timber Sale, the Airport Fuels Reduction Project broadcast burn and the Oak Creek Fuels Reduction Project.

Creation of grassy openings and a decrease in canopy cover is additive to similar effects in Pumphouse Multiproduct Timber Sale, the State Section 26 thinning and the Oak Creek Fuels Reduction Project.

Reduction of impacts from recreation and road management activities add to similar effects in the Griffiths Spring and Fort Tuthill to Kachina Village Trail Projects.

Invertebrates

Affected Environment

Three sensitive species of invertebrates are analyzed herein. They are spotted skipperling (*Piruna polingii*), mountain silverspot butterfly (*Speyeria nokomis nitocris*) and blue-black silverspot butterfly (*Speyeria nokomis nokomis*). These three butterfly species inhabit moist meadows, seeps, springs and streams within ponderosa pine and mixed conifer vegetation types and, in some cases, other habitat types with riparian areas. The two silverspot butterfly species have specific life cycle requirements where they use *Viola* species: adults feed on thistles.

There are no documented populations of these butterfly species within the project area, however, suitable habitat does exist in the canyons and at Lindberg Spring, Griffiths Spring and Kelly Seep. The canyons are deferred from treatment; therefore, those associated riparian areas would be unaffected. A survey for invertebrate species was conducted in the summer of 2000.

A rehabilitation project would be implemented at Kelly Seep under all action alternatives that includes removal of old dilapidated fencing and debris and installing new fencing around Kelly Seep to improve riparian habitat conditions.

Direct Effects of Alternatives A, B, C, D, and E

Under all action alternatives, thinning would occur near the springs and seep. The springs and seep and meadows around them would be protected, however some individuals may be impacted from treatment activities, including rehabilitation efforts at Kelly Seep. These effects would be minimal and short term.

Alternative B (No Action) would not directly impact these species.

Off-road driving across meadows and other recreation activities, such as hiking and biking, may impact habitat and harm eggs, individual adults, or larvae. Butterfly collecting would have a negative effect.

Indirect Effects of Alternatives A, B, C, D, and E

Improvement to Kelly Seep under all action alternatives will be beneficial to these butterfly species. Reducing the canopy closure, checking tree encroachment and removing trees in and at edges of meadows would be beneficial for these species.

Under Alternative B Kelly Seep would not be rehabilitated, thus there would not be any benefits to these species. Favorable habitat would decrease over time as conifers encroach meadows and canopy closure increases.

The high fire hazard potential would persist under Alternatives B and E. A large wildfire event may destroy some habitat and eggs laid by these species, and kill or harm individual adults or larvae, thus adversely impacting these butterfly species.

Cumulative Effects of Alternatives A, B, C, D, and E

The Griffiths Spring Parking and Interpretive Trail affects these species. Other projects do not specifically affect springs, seeps or meadows.

Past silvicultural practices targeted the harvesting of large trees and suppression of fires. This, in effect, created the dense forest condition we have today in the project area. A dense forest canopy hinders growth of vegetation on the forest floor. This, in turn, limits food availability and habitat substrate necessary for the life cycles of these species.

Impacts to individuals during implementation of thinning near springs and seeps, and implementation of the rehabilitation of Kelly Seep adds to similar impacts during the construction of the Griffiths Spring Trail and parking area. Other habitats in the area are not affected, and population viability is maintained.

Improved habitat resulting from rehabilitation of Kelly Seep adds to similar improvements at the Griffiths Spring site.

Improved habitat resulting from rehabilitation of Kelly Seep, reduction of canopy closure, and more and larger openings, offsets the lack of these habitat components in other areas of the landscape, and maintains habitat while there is a loss of habitat from development of private land.

Invasive and Noxious Weeds

The ponderosa pine forest on the Coconino National Forest has been greatly disturbed by logging, livestock grazing, roads, recreation, and the recent expansion of cities, towns and summer homes. Studies of the 1996 wildfires around Flagstaff revealed a nonnative flora of over 30 invasive, noxious plants such as Russian thistle (*Salsola kali),* cheatgrass (*Bromus tectorum*), Dalmatian toadflax (*Linaria dalmatica*), bull thistle *(Cirsium vulgare*) and other species (Crawford et al. 2000; Griffis et al. 2001). Noxious weeds in the project area include cheatgrass, Dalmatian toadflax, bull thistle and diffuse knapweed (*Centaurea diffusum*).

Nonnative plant species often out compete native species and may become established in disturbed areas before native species. Replacement of native plant species with invasive, noxious weeds may impact herbivore populations (reducing the number of individuals) that are prey species for other sensitive wildlife species.

A weed risk assessment will be completed for the preferred alternative for this project. Best management practices for weeds, integrated weed management practices for the Coconino, Kaibab and Prescott National Forests (Phillips et al. 2001), will be implemented. Many species of noxious weeds are anticipated to be less in 20 years due to the implementation of this project. The intent of this project is to help restore a healthy, functioning ecosystem that will contain a diversity of native species that would check or reduce competition of nonnative and noxious plants. Cheatgrass and Dalmatian toadflax may increase over time. The forest will continue to implement best management practices to contain and control noxious weeds.

Management Indicator Species

The National Forest Management Act of 1982 requires that the effects of each alternative on fish and wildlife be estimated and that "certain vertebrate and/or invertebrate species present in the area be identified and selected as management indicator species" (36 CFR 219.19(a)(1)). Management indicator species were identified and selected for the forest, as noted in the Forest Plan (USDA Forest Service 1996). Management indicator species affected by this project are discussed below.

Affected Environment

Forest indicator species predominately occur in mid-aged and mature stands, and do not indicate overall use patterns in the community or those of species of special concern. Passerine[20] bird use is highest in mature and especially old-growth stands. Passerine use by canopy density is evenly distributed with a slight preference for moderate canopies. Vegetative structural stage use by wildlife (Patton 1995, Benoit 1996) is fairly evenly distributed with slightly higher use in mature and old-growth forests and moderate and dense canopy stands. Young stands and open canopies are used the least. Large mammals follow an opposing pattern, with higher use occurring in openings, seedlings, and saplings than in mature or old-growth areas.

Existing human use in the Kachina Village FHP area is high. Road density is high, and there are many miles of social trails. High human use, combined with high road and trail densities, have the potential to impact all of the forest's MIS species and especially raptors, elk, passerine birds, turkey, and the northern goshawk in various ways. Human disturbance can cause raptors to abandon nests and move home ranges (Andersen, Rongstad and Mytton 1990, Vincenty 1974). Road use and recreation can cause elk and deer to draw within the woods to more quiet and undisturbed areas, with deer being more vulnerable to disturbance (Edge and Marcum 1991). The greatest impact area is 1/4 to 1/2 mile out from roads (Lyon et al. 1990, J.T. Thomas ed. 1979). Lack of wildlife cover and screening along roads exacerbates disturbance from road use (Gruell et al.

[20] A bird of the order passerineformes, examples are sparrows and bluebirds.

1976). Road use, off-road driving and trail use adversely impact turkeys; home ranges may be shifted and nests abandoned (Bailey and Rinell 1968, Holbrook and Vaughan 1985, Lindezey 1967). Jones and Barsch (1992) found that illegal take of wild turkey was high in northern Arizona, and that high road density is facilitating the illegal take of turkey. Some passerine birds are negatively affected from human presence, and other species are not (Garton et al. 1977, Van der Zande et al. 1984).

The following management indicator species are located within the project boundary and may potentially be affected from the project: Abert squirrel, elk, hairy woodpecker, mule deer, northern goshawk, pygmy nuthatch, and turkey.

Abert Squirrel

Abert squirrels are indicators of early seral stages of ponderosa pine forests (young to mid-age forests, VSS 3 and 4). The population of Abert squirrel on the Coconino National Forest is considered to be stable from 1998 through 2001 (Dodd 2002). Squirrels favor scattered large trees and multi-storied stands mixed with poles. The project area currently exhibits good quality habitat for Abert squirrel.

According to research conducted by Dodd, et al. (1998), Abert squirrels exhibit better recruitment and fitness in the ponderosa pine forest with tree groups of ≥ 5 interlocking canopy trees per clump, 9 groups per acre, and basal area of 150 sq. ft. per acre. They also recommend maintenance of ≥ 8 trees per acre that are 18+ inches in diameter. They showed that interlocking canopy trees are positively related to squirrel recruitment, and basal area is positively related to squirrel fitness.

Elk

Elk are indicators of early seral stages of conifer forests. Overall, elk are considered to be stable statewide (AGFD 2001b) and stable on the Coconino National Forest (USDA Forest Service 1999, 2001d). Productivity tends to be high and herds are located in all habitat types, even outside of ponderosa pine. The objective of the Arizona Game and Fish Department is to maintain a stable to gradually declining population over time, with specific objectives for specific areas (AGFD 2001a). Elk are found throughout the project area.

Hairy Woodpecker

This species is an indicator of snags in conifer forests for suitable nesting and feeding habitat. According to Latta et al. (1999), hairy woodpeckers are uncommon throughout their range yet common in their preferred habitat in Arizona. Their breeding distribution encompasses 51 to 75 percent of North America, including Mexico, and 26 to 50 percent of Arizona. This species is experiencing loss of suitable breeding habitat in the form of snags both range-wide and in Arizona. Arizona is considered to be of very low importance to this species since it represents < 1 percent of the species total breeding distribution. Breeding Bird Survey data shows declines in Mogollon Rim province, Colorado Plateau province, and the state (USDA Forest Service 1999).

Mule Deer

This species is an indicator of early seral stages of aspen/shrub and conifer forests. Statewide the mule deer population is declining (AGFD 2001b). Populations on Coconino National Forest are considered to be stable to declining, depending on location (USDA Forest Service 1999, 2001d). Mule deer are uncommon in the project area. Mule deer have the narrowest diet range of any North American ungulate. That is to say there is a limited number of plants they can use to their maximum dietary benefit. Deer tend to feed on forbs and browse with grasses in the spring and fall and, therefore, overlap somewhat with the other ungulates in the area. Deer are more cover dependent than elk. Excessive browse utilization has a relatively greater impact on deer compared to other species because it is a primary food item for them. Also, if other species (such as elk or domestic livestock) use browse before them, the larger twigs are not as easy to feed on or digest.

Northern Goshawk

This species is an indicator of late seral stages of conifer forests. Population trends are difficult to determine, but there is no hard evidence of a considerable decline; however, it is probably declining in some areas due to habitat alteration (The Nature Conservancy 1999). On the Coconino National Forest, northern goshawk territories have been monitored every year since 1989, with an average of 43 territories monitored from 1991 to 2001. The occupancy rate of territories has declined over these last 11 years; however, this does not signify a corresponding trend in population numbers. It is likely that nonbreeding goshawks would not be observed. During the later years of this time period, precipitation amounts have been below average. Climate may very well play an important role in whether or not northern goshawks breed in a given year, and would also influence nesting success of

northern goshawks. On Coconino National Forest, the population status is considered to be stable to declining. The northern goshawk is included in the Threatened, Endangered, and Sensitive Species section. Habitat capability modeling for northern goshawk is presented in this section.

Pygmy Nuthatch

Pygmy nuthatches are indicators of late seral stages of ponderosa pine. They are considered common throughout their range in North America, Mexico and Arizona. Moderate threats exist on breeding and wintering grounds both in Arizona and North America, defined as habitat loss. Arizona is considered to be of low importance to this species, representing 1 to 10 percent of the species' total breeding and wintering distribution (Latta et al. 1999). According to breeding bird survey data, the population was stable up to 1996. On the south end of the Coconino National Forest, the population crashed in 1996 and is slowly recovering (USDA Forest Service 1999).

Turkey

Turkey is an indicator of late seral stages of conifer forests, based on roost habitat requirements. Turkey population trends vary depending on location. In the project area, populations are stable to increasing, with a stable to slight decline in GMU 6B (USDA Forest Service 1999, 2001d).

Habitat Capability Modeling Description

The Habitat Quality Index (HQI) model was used for habitat capability modeling. Modeling was completed for seven management indicator species that would potentially be affected under the project: Abert squirrel, elk, hairy woodpecker, northern goshawk, mule deer, pygmy nuthatch, and turkey. HQI modeling is based on the value of forage and cover for vegetation type and structure and season of use. Forage includes any habitat that provides food for a species; vegetation for herbivores or prey for predators. Cover includes hiding, thermal, nests, or dens as habitat. The indices from HQI modeling for this project are used for relative comparisons between alternatives.

Action alternatives meet Forest Plan habitat capability desired conditions. Desired limits and acceptable changes regarding wildlife habitat capability are described in the monitoring plan section of the Forest Plan on pages 210 through 216.

Summary of Direct Effects for All Species for Alternatives A, B, C, D, and E

Under all action alternatives, disturbance to species would be reduced with management of recreation activities and road closures. Under all action alternatives, smoke effects from broadcast burning may disturb individual animals, although this would be short term and would not adversely affect any species.

Through time, based on estimated future VSS class distribution (see beginning of wildlife analysis section), Alternatives A, C and D would be more beneficial for late seral species due to greater increases in VSS 5 and 6 over the other alternatives. All alternatives would provide the same limited benefit to early seral species. Habitat would be provided for mid-seral species under all alternatives.

Under Alternative B elk, mule deer, northern goshawk, and turkey would be negatively affected by disturbance from recreation activities and road traffic; animals may move home ranges and may abandon nesting areas.

Indirect Effects for All MIS Species for Alternatives A, B, C, D, and E (Habitat Quality Index)

Under Alternative B, due to no change in current conditions, the high fire hazard potential would persist. Alternative E would present the same high fire hazard potential as Alternative B (refer to Fire Effects section). In the advent of a large wildfire under these two alternatives, forest habitat would be destroyed and population viability of forest-dependent species would be adversely affected. Alternatives A, C and D would reduce the threat of a wildfire event.

Abert squirrel Habitat Quality Index

Under Alternatives A, C, and D, cover would decline and forage would improve compared to existing conditions. The project area would be dominated by high quality forage (68.5 percent) and moderate quality cover (41.5 percent). High quality cover would occur over 24.3 percent of the project area. There are some areas that would not offer any forage value (16 percent) or cover value (16 percent).

Under Alternative E, cover would also decline and forage would also improve, but not to the same degree as under the other action alternatives due to the lesser amount of thinning south of Kelly Canyon.

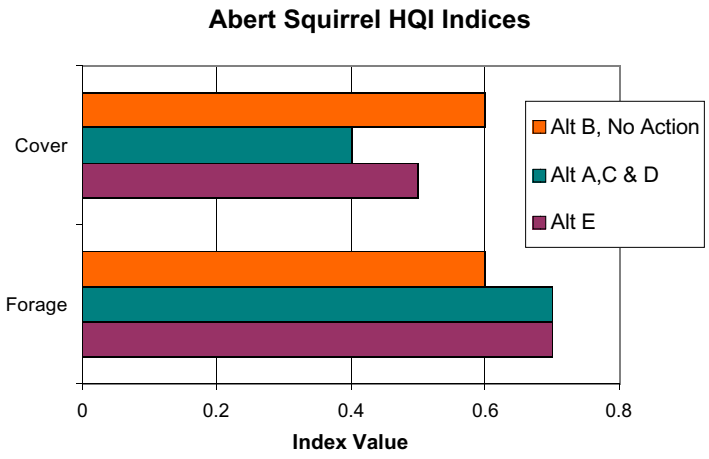

Figure 28. Results of Habitat Capability Modeling for Abert Squirrel

The project area would be dominated by high quality forage (63.5 percent) and moderate quality cover (43.6 percent). High quality cover would occur over 29.3 percent of the project area. There are some areas that would not offer any forage value (17.7 percent) or cover value (17.7 percent).

Under Alternative B, No Action, the project area is dominated by high quality forage (65.2 percent) and high quality cover (45.9 percent). Moderate quality cover occurs over 32 percent of the project area. There are some areas that do not offer any forage value (13.8 percent) or cover value (13.8 percent).

The Forest Plan requires to manage for at least 20 percent of potential habitat capability for Abert squirrel in 10K blocks as determined by the forest habitat capability model (page 125). All alternatives provide greater than 20 percent forage and cover habitat.

Considering cover and forage together, Alternative B offers the best quality habitat for Abert squirrel. On the other hand, the action alternatives would not greatly impact Abert squirrel, and would enhance habitat by creating uneven-age stand structure with tree clumping and edge effects. Edge effects are important for feeding opportunities (Dodd et al. 1998); squirrels could visit trees that produce more cones as the trees would be released from competition due to thinning treatments. With the modest estimated change in HQI from existing conditions, the action alternatives may not have a detectable effect on the population trend of Abert squirrel on the Coconino National Forest. Additional population monitoring may occur as a result of proposed research and monitoring submitted by Arizona Game and Fish Department (see Chapter 2, "Monitoring").

Elk Habitat Quality Index

Under Alternatives A, C, and D, cover would decline and forage would improve compared to existing conditions. The project area would be dominated by moderate quality forage (65.4 percent) and moderate quality cover (51.5 percent). High quality forage (7.4 percent) and high quality cover (16 percent) would occur but would be limited. There are some areas that would not offer any forage value (24.5 percent) or cover value (30.9 percent).

Under Alternative E, cover would also decline but not to the same degree as under the other action alternatives due to the denser condition of the forest in areas where a 9-inch diameter limit is imposed. Forage value would remain the same as under Alternative B, No Action. The project area would be dominated by moderate quality forage (64.9 percent) and moderate quality cover (55.3 percent). High quality forage (2.7 percent) and high quality cover (19.2 percent) would occur but would be limited. There are some areas that would not offer any forage value (28.2 percent) or cover value (23.9 percent).

Under Alternative B (No Action), the project area is dominated by moderate quality (44.7 percent) to low quality forage (16.5 percent). High quality forage is

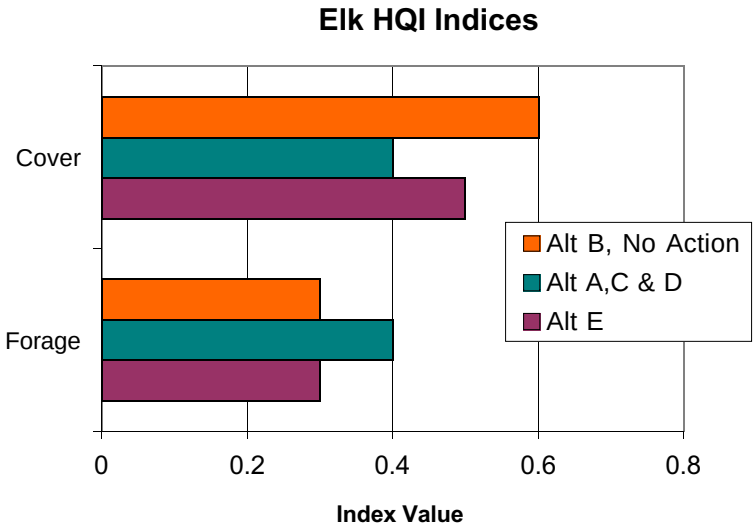

Figure 29. Results of Habitat Capability Modeling for Elk

only represented by 2.1 percent of the project area. High quality cover occurs over 44.2 percent of the project area. There are some areas that do not offer any forage value (36.7 percent) or cover value (16.5 percent).

There would be adequate cover under all alternatives. Best foraging opportunities would occur under Alternatives A, C and D. Considering cover and forage together, all action alternatives would improve habitat quality for elk, with Alternatives A, C and D offering better habitat quality. The creation and/or expansion of openings and broadcast burning will stimulate understory plant growth. This would provide more forage for elk. Thermal and hiding cover will continue to be provided. With the modest estimated change in HQI from existing conditions, the project may not have a detectable effect on the population trend of elk on the Coconino National Forest.

However, elk population numbers are affected by hunting regulations governed by the Arizona Game and Fish Department and the number of elk permits issued. The goal of the Arizona Game and Fish Department is to decrease the number of elk on the forest with specified goals associated with specific Game Management Units (GMU's) (AGFD 2001a). The Kachina Village FHP falls into GMU's 6A, 6B and 7M (this is a metro unit created from parts of 5B, 6A and 7 in 2001). The goal of Arizona Game and Fish is to continue reductions of elk in the project area (AGFD 2001a).

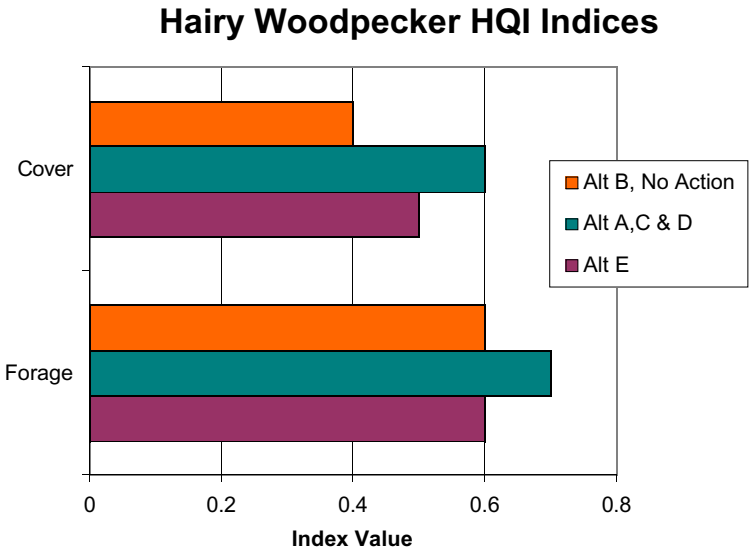

Figure 30. Results of Habitat Capability Modeling for Hairy Woodpecker

Hairy Woodpecker Habitat Quality Index

Under Alternatives A, C, and D, cover and forage would improve compared to existing conditions. The project area would be dominated by high quality forage (55.2 percent) and high quality cover (59.6 percent). There are some areas that would not offer any forage value (18 percent) or cover value (31.1 percent).

Under Alternative E, cover would also improve but not to the same degree as under the other action alternatives. Forage value would remain the same as existing conditions. The project area would be dominated by high quality forage (51.4 percent) and high quality cover (45.9 percent). There are some areas that would not offer any forage value (20.2 percent) or cover value (42.1 percent).

Under Alternative B (No Action), the project area is dominated by high quality forage (54.1 percent). High quality cover occurs over 30.1 percent of the project area, with low quality cover over 31.7 percent of the project area. There are some areas that do not offer any forage value (15.9 percent) or cover value (38.2 percent).

Considering cover and forage together, Alternatives A, C, and D would offer better habitat quality. The greatest increase in VSS 5 class would occur under these three alternatives. This class contains large trees which are recruitment trees for snags. With the modest estimated change in HQI from existing conditions, the project may not have a detectable effect on the population trend of hairy woodpecker on the Coconino National Forest. Additional population monitoring may occur as a result of proposed research and monitoring submitted by the Arizona Game and Fish Department and Ecological Research Institute in cooperation with Northern Arizona Audubon Society (see Chapter 2, "Monitoring").

Northern Goshawk Habitat Quality Index

Under Alternatives A, C, and D, cover would improve and forage value would remain the same compared to existing conditions. The project area would be dominated by high quality forage (66.7 percent) and high quality cover (37.7 percent). There are some areas that would not offer any forage value (15.3 percent) or cover value (34.4 percent).

Under Alternative E, cover would also improve but not to the same degree as under the other action alternatives. Forage value would

decline compared to existing conditions. The project area would be dominated by high quality forage (55.2 percent) and high quality cover (42.1 percent). There are some areas that would not offer any forage value (16.9 percent) or cover value (47 percent).

Under Alternative B (No Action), the project area is dominated by high quality forage (62.3 percent). High quality cover occurs over 27.9 percent of the project area, with low quality cover over 24.6 percent of the project area. There are some areas that do not offer any forage value (10.9 percent) or cover value (45.3 percent).

Considering cover and forage together, Alternatives A, C, and D would offer better habitat quality. With the modest estimated change in HQI from existing conditions, the project may not have a detectable effect on the population trend of northern goshawk on the Coconino National Forest. (See Figure 31.)

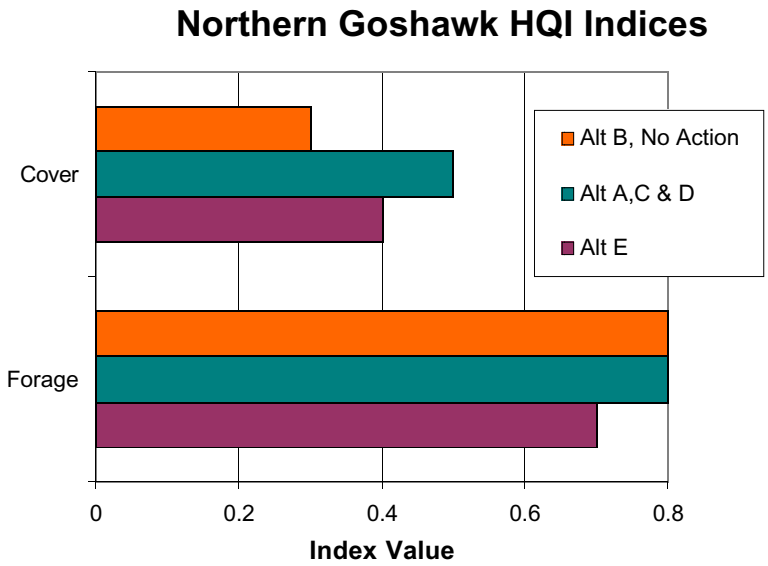

Figure 31. Results of Habitat Capability Modeling for Northern Goshawk.

Mule Deer Habitat Quality Index

Under Alternatives A, C, and D, cover would decline and forage would improve compared to existing conditions. The project area would be dominated by moderate quality forage (44.1 percent) and high quality cover (40.4 percent). High quality forage would occur over 28.7 percent of the project area. There are some areas that would not offer any forage value (24.5 percent) or cover value (17.6 percent).

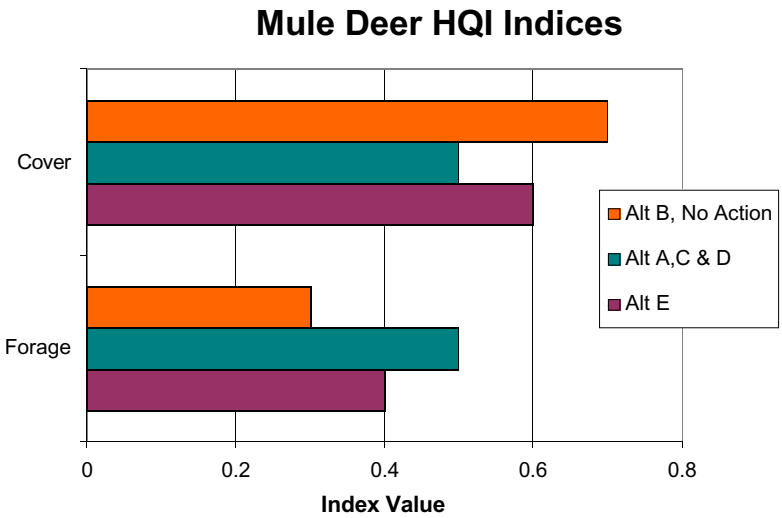

Figure 32. Results of Habitat Capability Modeling for Mule Deer.

Under Alternative E, cover would also decline and forage would also improve but not to the same degree as under the other action alternatives due to the lesser amount of thinning south of Kelly Canyon. The project area would be dominated by moderate quality forage (56.4 percent) and high quality cover (50 percent). High quality forage would be limited and occur over 11.2 percent of the project area. There are some areas that would not offer any forage value (28.2 percent) or cover value (19.1 percent).

Under Alternative B (No Action), the project area is dominated by moderate quality forage (37.2 percent) and high quality cover (68.1 percent). High quality forage is limited and occurs over 9.6 percent of the project area. There are some areas that do not offer any forage value (36.7 percent) or cover value (13.3 percent).

Considering cover and forage together, Alternatives A, C, and D offer the best quality habitat for mule deer. Thinning of stands, creation and/or expansion of openings, and broadcast burning will stimulate understory plant growth. This would provide more forbs and browse for mule deer. Thermal and hiding cover will continue to be provided. With the modest estimated change in HQI from existing conditions, the project may not have a detectable effect on the population trend of mule deer on the Coconino National Forest.

Additionally, mule deer is hunted in Arizona and populations are affected by hunting pressures. The goal of the Arizona Game and Fish Department is to increase the number of mule deer (AGFD 2001b). Additional population monitoring may occur as a result of proposed research and monitoring submitted by the Arizona Game and Fish Department (see Chapter 2, "Monitoring").

Pygmy Nuthatch Habitat Quality Index

Under Alternatives A, C, and D, forage and cover values would improve. The project area would be dominated by high quality forage and cover (58.5 percent for both). Low quality forage and cover would occur over 25.7 percent of the project area. There are some areas that would not offer any forage or cover value (15.8 percent for both). There would be no moderate quality forage or cover.

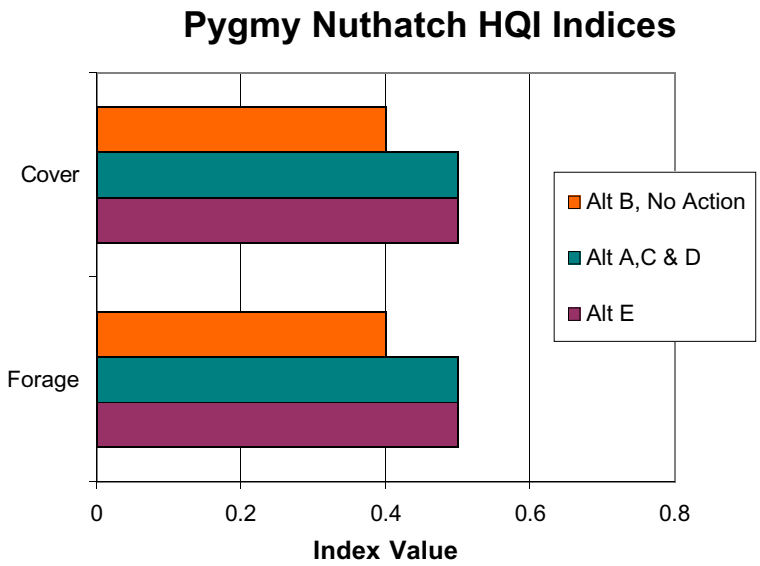

Figure 33. Results of Habitat Capability Modeling for Pygmy Nuthatch

Under Alternative E, forage and cover values would improve the same degree as under the other action alternatives. The project area would be dominated by high quality forage and cover (44.8 percent for both). Low quality forage and cover would occur over 37.7 percent of the project area. There are some areas that would not offer any forage or cover value (17.5 percent for both). There would be no moderate quality forage or cover.

Under Alternative B (No Action), the project area is dominated by low quality forage and cover (57.4 percent for both). High quality forage and cover occur over 28.9 percent of the project area. There are some areas that do not offer any forage or cover value (13.7 percent for both). There is no moderate quality forage or cover.

Considering cover and forage together, Alternatives A, C and D offer the best quality habitat for pygmy nuthatch. These three alternatives would increase the percentage of late seral stages of the forest the most. With the modest estimated change in HQI from existing conditions, the project may not have a detectable effect on the population trend of pygmy nuthatch on the Coconino National Forest. Additional population monitoring may occur as a result of proposed research and monitoring submitted by the Arizona Game and Fish Department and Ecological Research Institute in cooperation with Northern Arizona Audubon Society (see Chapter 2, "Monitoring").

Turkey Habitat Quality Index

Under Alternatives A, C and D, summer forage and cover and winter cover values would decline compared to existing conditions. Winter forage value would improve. High quality summer forage and summer cover would be limited and occur over 20.2 percent of the project area. Moderate quality summer forage and cover habitat would be dominant and occur over 43.7 percent of the project area. Fifteen percent of the project area would not offer any summer forage or cover. Winter habitat would be dominated by high quality forage (38.2 percent) and moderate quality cover (42.6 percent). Moderate quality winter forage habitat would occur over 37.2 percent of the project area. High quality winter cover would be limited (14.2 percent). There would be some areas that would not offer any winter forage or cover value (16.4 percent for both).

Under Alternative E, summer forage and cover and winter cover values would decline. Winter forage value would improve compared to existing conditions. Moderate quality summer habitat would be dominant and occur over 53 percent of the project area. High quality summer forage and summer cover would be limited and occur over 22.4 percent of the project area. There would be some areas that would not offer any summer forage or cover value (16.9 percent for both). Winter habitat would be dominated by moderate quality forage (47.5 percent) and moderate quality cover (59 percent). High quality winter forage and winter cover would be limited (23 percent and 14.2 percent, respectively).

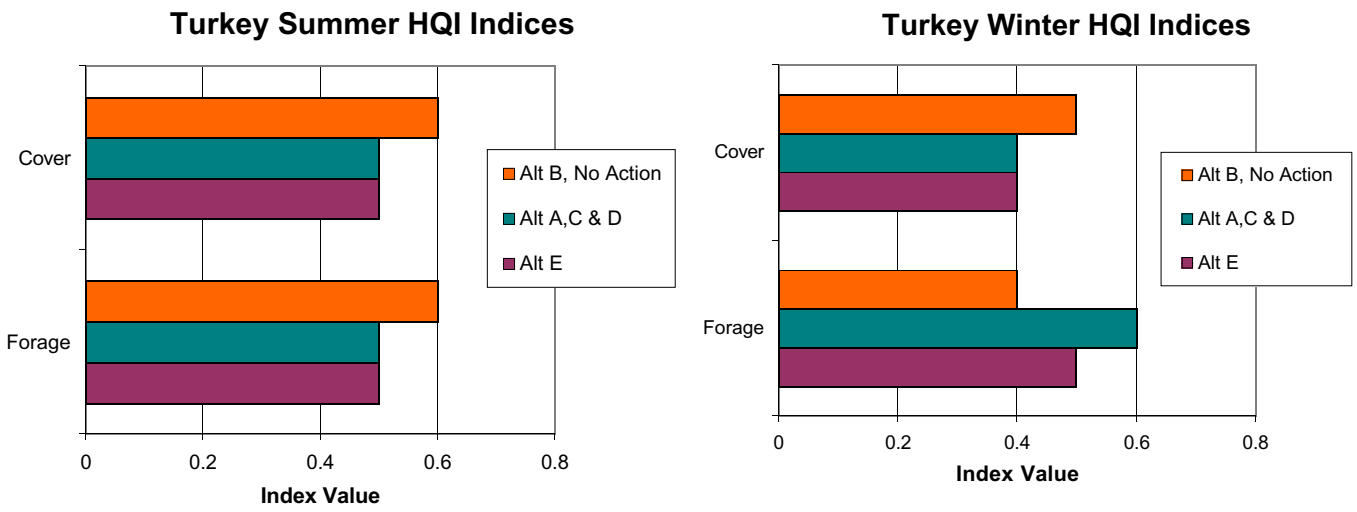

Figure 34. Results of Habitat Capability Modeling for Turkey

Some areas would not offer any winter forage or cover value (18 percent for both).

Under Alternative B, No Action, summer forage and cover habitat is dominated by moderate quality habitat (54.6 percent for both). High summer forage and cover habitat covers 27.9 percent of the project area. Some areas do not offer any summer forage or cover value (10.9 percent for both). Winter habitat is dominated by moderate quality forage (42.1 percent) and moderate quality cover (48.6 percent). High quality winter forage is limited (17.5 percent). High quality winter cover occurs over 32.3 percent of the project area. There are some areas that do not offer any winter forage or cover value (12 percent for both).

There is a mix in habitat values across alternatives. The HQI values may not adequately represent conditions for turkey. The other species analyzed herein have year-round habitat, while turkey have distinct summer and winter ranges. Turkeys forage and nest on the ground in openings or at edges and roost in large, old trees. Alternatives A, C and D would offer the most foraging and nesting habitat based on more created openings. Openings would promote greater amounts and vigor of growth of the understory vegetation and offer more edge effect. These three action alternatives would also offer the most roosting habitat due to an increase in VSS 5 class (refer to Tables 18, 19, and 20 at the beginning of the wildlife habitat section). With the modest estimated change in HQI from existing conditions, the project may not have a detectable effect on the population trend of turkey on the Coconino National Forest.

Additionally, turkey is a game species in Arizona and populations are affected by hunting pressures. The goal of the Arizona Game and Fish Department is to increase the number of turkey (AGFD 2001b). Additional population monitoring may occur as a result of proposed research and monitoring submitted by the Arizona Game and Fish Department and Ecological Research Institute in cooperation with Northern Arizona Audubon Society (see Chapter 2, “Monitoring”).

Cumulative Effects for All MIS Species for Alternatives A, B, C, D, and E

Projects considered for the discussion that follows are those listed in the introduction of this chapter.

Historical silvicultural practices of removing large-sized trees and suppression of fires created a forest of existing conditions seen today. This current condition is not beneficial to most management indicator species.

In the long term, the development of forests that exhibit a mosaic of habitats creates a positive cumulative effect as treatments in this project and other areas produce a forest structure that would benefit many management indicator species.

The short-term effects of implementation activities associated with thinning, recreation and road management and rehabilitation of Kelly Seep are in addition to similar implementation of the other projects. However, the timing of implementation varies so that most of these projects will not be occurring simultaneously.

The direct short-term effects of smoke disturbance to individuals adds to similar effects in the Pumphouse Multiproduct Timber Sale area, the Airport Fuels Reduction Project broadcast burn, the Oak Creek Fuels Reduction Project area and State Section 26 burning. However, because ADEQ regulates burning, it is unlikely that these burns would occur simultaneously or even consecutively. These effects are short term and would not adversely affect any species.

The reduction of human disturbance through recreation and road management activities is additive to similar effects in the Griffiths Spring and Fort Tuthill to Kachina Trail Projects. This reduction in human disturbance offsets other instances of disturbance in other areas. However, this cumulative effect is not great.

The changes in the amount and distribution of cover and forage for management indicator species is additive to similar affects which have or will occur in the Pumphouse Multiproduct Timber Sale, the Oak Creek Fuels Reduction Project and State Section 26. However, for all species there is a modest change in HQI from existing conditions that may not have a detectable effect on population trends, so there is no added effect to population trends from this project.

Table 27. Listing of Priority Migratory Bird Species, by Habitat Type, (Latta et al. 1999) That Are or Have the Potential to be Found within the Kachina Village Forest Health Project Area.

Bird Species	Mixed Conifer	Ponderosa Pine, Pine-Oak	High Elevation Grassland	High Elevation Riparian
Northern goshawk	X	X		
Mexican spotted owl	X	X		
Olive-sided flycatcher	X	X		
Cordilleran flycatcher		X		
Purple martin		X		
Ferruginous hawk			X	
Swainson's hawk			X	
MacGillivray's Warbler				X
Red-faced Warbler				X

Table 28. Special Factors for Mixed Conifer Priority Species (Latta et al. 1999).

Priority Species	Special Factors
Olive-sided Flycatcher	Dietary: flying insects, esp. bees and wasps. Highly territorial on breeding and wintering grounds. High degree of foraging specialization only sallies for insects no gleaning from leaves or ground. Strong site fidelity in both breeding and wintering grounds. Declines may also be related to destruction of wintering habitat (from high site fidelity). Need snags higher than surrounding canopy. Rare cowbird host.

Neotropical Migratory Birds

Affected Environment

Following is a listing of priority migratory bird species by habitat type (Latta et al. 1999) that are, or have the potential to be, found within the project area. Northern goshawk and Mexican spotted owl are discussed in the early pages of this document. Mixed conifer habitat is found within the canyons and is deferred from treatment.

Olive-sided flycatcher is associated with forest openings and edges with numerous dead trees and live mature pines. This flycatcher is a rare cowbird host.

Cordilleran flycatcher is associated with mid- to late-successional stages with dense canopy closure and drainages that create a cool microclimate. This flycatcher is a rare cowbird host.

Purple martin is associated with open canopy, open mid-story and open understory cover, and high snag density.

Swainson's hawk is uncommon during June, July and during migration and prefers larger openings than found on the project.

Ferruginous hawk is a migrant or uncommon during the winter, using openings much larger than in this project.

Table 29. Special Factors for Ponderosa Pine and Ponderosa Pine-Gambel Oak Priority Species (Latta et al. 1999).

Priority Species	Special Factors
Olive-sided Flycatcher	Same as for mixed conifer.
Cordilleran Flycatcher	Need snags and downed trees for nesting. Rare cowbird host.
Purple Martin	Often prefers habitat near open water. Prefers tall snags adjacent to open areas.

Table 30. Special Factors for High Elevation Grassland Priority Species (Latta et al. 1999).

Priority Species	Special Factors
Ferruginous Hawk	Occur where larger populations of prairie dogs, ground squirrels, rabbits and pocket gophers exist. High sensitivity to human disturbance around nests.
Swainson's Hawk	Eat grasshoppers during migration and on wintering grounds. Have a wider variety of food sources than Ferruginous hawks: i.e., lizards, snakes, birds, ground squirrels, voles, and pocket gophers. Non-breeders hunt communally and eat primarily insects. Not as sensitive to human disturbance as Ferruginous Hawks.

Table 31. Special Factors for High Elevation Riparian Priority Species (Latta et al. 1999).

Priority Species	Special Factors
MacGillivray's Warbler	Obligate understory (dense) nester. Primarily breed in the White Mountains and locally above the Mogollon Rim, in a relatively small geographic area.
Red-faced Warbler	Ground nester.

MacGillivray's warbler is associated with dense understory and riparian habitat at edges of conifer and deciduous forests. Red-faced warbler is associated with mid-story and dense stands, not necessarily tied to dense understory, and is found mostly in steep canyons. Both species are associated with the canyons in the project area.

Direct Effects of Alternatives A, B, C, D, and E

There would be no direct effects to migratory bird species discussed here.

Indirect Effects of Alternatives A, B, C, D, and E

Under Alternatives A, C and D, effects from thinning and broadcast burning treatments would benefit the olive-sided flycatcher and purple martin due to the creation of openings and the retention of snags and large trees. These three alternatives offer the least amount of dense forest canopy favored by the Cordilleran flycatcher. However, the small number of snags across the project area would limit the distribution of the purple martin. There would be little to no benefit for Swainson's hawk or ferruginous hawk because of the lack of large open lands. Canyons are deferred from treatment; therefore, there would be no affect to MacGillivray's warbler or red-faced warbler.

Alternative E would benefit olive-sided flycatcher and purple martin north of Kelly Canyon due to the creation of some openings. However, the small number of snags across the project area would limit the distribution of the purple martin. This alternative would retain dense stands south of Kelly Canyon and would favor cordilleran flycatcher. There would be no affect to Swainson's hawk, ferruginous hawk, MacGillivray's warbler or red-faced warbler. Additionally, Alternative E would not reduce the high fire hazard potential south of Kelly Canyon due to the 9-inch diameter limit.

Alternative B would retain dense stands and would favor cordilleran flycatcher. Additionally under Alternative B, the high fire hazard potential would persist. In the advent of a large wildfire, habitat for all species, except Swainson's hawk and ferruginous hawk, would be destroyed.

Cumulative Effects of Alternatives A, B, C, D, and E

Past silvicultural practices targeted the harvesting of large trees and suppression of fires. This, in effect, created the dense forest condition we have today in the project area that favors the cordilleran flycatcher.

Other projects considered are those described in the introduction of this chapter.

There are no direct effects from any of the alternatives and, therefore, no added affect when combined with other projects in and surrounding the Kachina FHP.

The indirect effect of creation of openings and retention of snags (Alternatives A, C and D) adds to similar effects that have or will occur in the Pumphouse Multiproduct Timber Sale, the Oak Creek Fuels Reduction Project and State Section 26.

Cultural Resources

Affected Environment

The Kachina Village Forest Health Project area contains a variety of non-renewable historic and prehistoric archaeological sites that reflect past land uses.

Archaeological evidence indicates that prehistoric use was focused on seasonal hunting, gathering, and food processing activities. Potential water sources in the area, such as precipitation runoff catchments and springs, probably attracted game and supported a diverse vegetative community that, in turn, attracted prehistoric people to the area to exploit these subsistence resources. Known prehistoric sites within the project area consist of limited activity lithic scatters, probably representing temporary camps. These sites probably range from Archaic to Proto-historic in age.

The project area is located at a relatively high elevation and contains several historic archaeological sites, including cabins, homesteads, and a historic cabin.

The project area may have been traditionally used by many Native American tribes, and the area has potential for continued, current use.

Direct Effects of Alternatives A, B, C, D, and E

Potential direct effects to cultural resources as a result of implementation of the alternatives include hand and mechanical thinning; lopping and scattering, piling, and windrowing slash; and pile, broadcast, and maintenance broadcast burning. Specific nonground-disturbing treatments may be allowed within prehistoric and historic archaeological sites that will contribute to the accomplishment of project objectives (reducing fuel loading and the risk of catastrophic wildfire) without affecting major qualities of the sites.

The archaeological clearance for the project documents the archaeological inventory, results of consultations with the tribes, and the determination of no adverse effect in compliance with the National Historic Preservation Act of 1966, as amended. The clearance report contains site-specific protection measures for implementation and monitoring requirements.

Consultations with tribes resulted in no specific concerns about the effect of the proposal. Tribal access will not be affected by the proposed project.

There are no direct effects from Alternative B.

Indirect Effects of Alternatives A, B, C, D, and E

Reducing fuel loads using methods that are nonground disturbing on and around archaeological sites is the most effective management tool for reducing the severity of potential wildfire damage and associated indirect effects such as erosion, enhanced visibility, and fire suppression damage to these nonrenewable resources.

Cumulative Effects of Alternatives A, B, C, D, and E

Since there is not an adverse effect to cultural resources because of the project activities, there is no added effect as a result of this project.

Economics

Economic analysis was conducted using techniques and methods developed by Dr. Debra Larson of Northern Arizona University. The analysis focused on the economic question of how 16 inch and

greater diameter trees would contribute to total return estimates. Modeling runs were conducted using two product mixes and two logging systems reflecting local markets. Alternative B (No Action) could potentially result in a loss of over 1 billion dollars if Forest Highlands Subdivision were impacted severely by a large catastrophic fire event (Jim Pond, Highlands Fire Department personal communication). The cost to fight such a fire was estimated at 3 million dollars. Long-term impacts to Oak Creek Canyon, wildlife habitat and T&E habitat would be significant. Alternative A without a 16-inch diameter limit would result in a positive 5 to 10 percent change per CCF when compared to Alternative C. The estimated value of the 7,000 trees thinned using Alternative C is approximately $175,000 based on an estimated value per CCF, which is taken from Larson, D. 2000 (in press). However, given the poor tree form expected of the 16-inch diameter trees removed, the grade of these trees may not be realized in the market.

Table 33 shows the estimated present net value of each of the individual projects, and the alternative as a whole.

Direct and Indirect Effects

A brief financial cost analysis utilizing professional experience and knowledge and information and cost analysis for thinning activities provided by Dr. Debra Larson of Northern Arizona University was found to be the best fit, as economics was not identified as a major issue or objective for this project. The cost analysis conducted for thinning allowed us to look at both local logging systems and available markets to predict costs.

None of the alternatives result in a positive net return. Alternative A is the least expensive to implement. Of the action alternatives, Alternative A is the least expensive to implement due to the value of harvesting 16-inch plus trees and the total volume harvested with the 50 basal area cuts resulting in the higher returns. These values do not represent total cost to the taxpayer, because both volunteer labor and private funding may be used to complete some of these projects.

Alternative C has a cutting limit of 16-inches diameter. Trees larger than 16 inches in diameter left uncut by a cap can have an effect on the eco-

Table 32. Comparison of Cost Per Thousand Cubic Feet (CCF), Number of Trees Removed Greater than 16 inches dbh, and Estimated Value for All Action Alternatives.

Economic	Alternative			
Evaluation	A	C	D	E
Number of 16 and greater diameter trees removed	5,000 (16.1 to 17.9) 2,000 (18 +)	0	5,000 (16.1 to 17.9)	0
Estimated Value of 16" and greater diameter trees	$498,000	0	$373,500	0

Table 33. Estimated Present Net Value of Each Project and Alternative

	Alternative			
Project	A	C	D	E
Thinning	+510,090	+238,886	+402,045	670,975
Road Closures, Road Obliteration	10,500	10,500	10,500	10,500
Broadcast Burn	1,245,800	1,245,800	1,245,800	1,245,800
Riparian Restoration	10,000	10,000	10,000	10,000
Snag and Log Creation	50,000	0	25,000	0
Trails and Dispersed	175,000	175,000	175,000	175,00
Total Cost	981,210	1,202,414	1,064,255	2,112,275

nomics of this project. A report done by Debra Larson summarizes the economic impacts to operators if a 16-inch dbh cutting limit had been imposed over the Fort Valley Research and Demonstration Projects (PRD Fort Valley 309.). She found that in absence of a pulpwood market, that two to three 16-inch dbh plus trees per acre harvested can have a positive economic value.

Economic impacts of thinning trees less than 16 inches (Alternative C) have been transcribed from the Larson report and are included below.

"The cost to conduct a forest thinning program to reduce the risk of catastrophic fire and restore forest ecosystem health is substantial.

Establishing a cap, which prohibits the cutting of 16-inches dbh and greater trees, has a negative effect on the economics of a forest thinning project.

Though the number of 16 to 21.9-inch dbh trees available for cutting in Fort Valley represents only a small percentage of the standing large trees, these trees represent a disproportionately large percent of the total volume to be cut, with profound effects on project economics. Larson's report only referenced the R and D plots, but the same effect applies to the entire Fort Valley project.

Economic effect of the 16-inch cap is related to the health of the Regional wood fiber market. A healthy market could support a restoration program, even with a cap. The current weak, subsistence market, probably cannot support the operators, if a cap is imposed."

Using Larson's calculation of a net loss to the operator of approximately $83 per tree if a 16-inch diameter limit is in place, 16-inch trees represent an approximate value of $498,000 in Alternative A and $373,500 in Alternative D.

The Forest Service has received comments that it failed to consider such indirect impacts as externalized economic costs of logging, such economic value on existing uses and functions of the area including: hiking, camping, mountain biking, horseback riding, cross country skiing, snowmobiling, sight seeing and use of outfitter/guide services, flood control, pest control, carbon sequestering, and many other "ecosystem services." In addition, these comments assert that our economic analysis fails to consider a wide range of costs that will be incurred by the public through loss of these "ecosystem services" and other externalized costs such as increased flooding, increased risk of death, injury, and property damage from logging operations, and increased fire risk.

The Forest Service has not received any comments from recreational users and/or outfitter/guide operators that Alternative A will impact their experience financially. Flood and other watershed questions are addressed in other effects discussion. This analysis considered loss of "ecosystem services," and the other externalized cost mentioned above and found either no impact, or at an inappropriate level of analysis for the Kachina Village Forest Health Project.

Cumulative Effects

The Flagstaff economy is very diverse. The forestry or logging sector makes up only a small percentage of the overall local economy. Jobs created by these activities include the continued development of markets for utilization of products in northern Arizona. New market development across the Southwest is very important in continuing treatments to reduce wildfire potential and improve forest health. This project may result in cumulative benefits to the employment and creation of new markets in the region.

Environmental Justice

The issue of environmental equity and justice in natural resource allocation and decision making is receiving increasing political and social attention. Following President Clinton's Executive Order 12898 (Federal Register, February 1994) all Federal land management agencies have been mandated to address environmental justice in nonwhite and/or low-income populations, with the goal of achieving environmental protection for all communities regardless of their racial and economic composition.

Alternatives A, B, C, D, and E do not result in disproportionate impacts to low-income populations, nor do they impact minority populations. As stated in the economics section above, the overall economy of the Flagstaff area, including its low income and minority populations, is diverse. The Flagstaff economy is strongly tied to the tourism industry, with forest products a very small percentage of the overall economy. Tourists are often traveling to destination points such as Flagstaff, the Grand Canyon, Oak Creek Canyon, or Sedona. Although tourists traveling on I-17 and Highway 89A appreciate the forest view, they would likely still travel to their destinations regardless of changes in that view.

4 • List of Preparers

Name	Position/ Organization	Contribution	Education	Relevant Years of Experience
Beard, James	Forest Landscape Architect, Coconino National Forest	ROS and Visual Scenery Management	B.S Landscape Architect	27
Brown, Alvin	Environmental Coordinator, Peaks and Mormon Lake Ranger Districts, Coconino National Forest	Staff and NEPA Consultation	B.S. Forestry	26
Denton, Lori	Recreation Forester	Recreation	B.S. Recreation Management	11
Geesey, Brenda	GIS Coordinator, Peaks and Mormon Lake Ranger Districts, Coconino National Forest	Spatial Analysis Maps	B.S. Natural Resources and M.S. Forestry	12
Hannemann, Michael	District Range Staff, Acting District Ranger, Peaks and Mormon Lake Ranger Districts, Coconino National Forest	Rangeland and Vegetative Understory	B.S. Wildlife Biology and M.S. Forestry	18
Hink, Jeff	Soil and Water Specialist, Peaks Ranger District, Coconino National Forest	Soil/Water Analysis	B.S. Natural Resource Management	26
Kill, Debbie	NEPA Coordinator, Peaks Ranger District, Coconino National Forest	NEPA Analysis	B.S. Forestry	12
Maloney, Edward	Archaeologist, Peaks and Mormon Lake Ranger Districts, Coconino National Forest	Heritage Resources	B.A. Anthropology/Geology	2
McGuinn, Deb	Wildlife Biologist, Peaks Ranger District, Coconino National Forest	Wildlife Analyses	B.S. Biology and M.S. Biology	15
Randall-Parker, Tammy	Wildlife Biologist, Environmental Coordination Group, Peaks and Mormon Lake Ranger Districts, Coconino National Forest	IDT Leader Wildlife Biologist	B.S. Biology and B.S. Zoology	15
Stahn, Richard	Silviculturist, Mormon Lake Ranger District, Coconino National Forest	Silviculture	B.S. Forestry/ Watershed Management	27

Name	Position/ Organization	Contribution	Education	Relevant Years of Experience
Standing, Paul	District Engineer, Peaks Ranger District, Coconino National Forest	Transportation Planning and Roads Analysis		36
Thornton, Bruce	Center Fuels Specialist, Flagstaff Center, Coconino National Forest	Fuels and Fire Behavior Air Quality/Smoke	B.S.B.A. Fire Behavior Analysis, Graduate of Prescribed Fire Management	27

5 • List of Agencies, Organizations, and Persons to Whom Copies of the DEIS are Sent

Federal Agencies

U.S. Fish and Wildlife Service
Federal Highway Administration
USDA NRCS-SCS
USDA Forest Service, Rocky Mountain Research Station

State Agencies

SHPO Arizona State Parks
ADEQ
Arizona Department of Transportation
Arizona State Land Department
Arizona Game and Fish Department

Individuals

Roxanne George
John Murphy
Mary Sojourner
Joe Manterola
Wayne and Eloise Schmidt
Judy Sellers
Tom Hanson
Barbara Alexander
Peter Kloeber
Rich Metzner
Sharon Cherrix
Wally Blanchard
Ginger Jervey
Scott Swegle
Tom Armstrong
Sue Cardiff
John Dale
James Judoth
Rene and Matt Vorta
Adrien Elseroad
Pam Gesla
S. Bleich

County Agencies

Coconino County Planning
Coconino Rural Environmental Corp
Coconino Board of Supervisors

Colleges and Universities

NAU School of Forestry
NAU School of Engineering
NAU Ecological Restoration Institute

Local Governments/Agencies/ Businesses

Highlands Fire Department
Citizens Utilities
KNAZ TV 2
KNAU
City of Flagstaff Fire Department
Cocopai RC&D
RMRS
Flagstaff Chamber of Commerce
Arizona Public Service
Native Plant and Seed
Precision Pine and Timber
High Desert Investments
Windmill Ranch

Organizations

Society of American Foresters
Arboretum at Flagstaff
Forest Conservation Council
Forest Guardians
Plateau Group Sierra Club
Grand Canyon Trust
SW Forest Alliance
Center for Biological Diversity
N. Arizona Cattle Growers Assoc
National Forest Protection
The Nature Conservancy

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Appendix A • Scoping Comment Analysis

Scoping Comment Summary Final November 2001

This document lists all comments received in response to the Proposed Action and subsequent clarification comments and discussions. The comments are listed here as either preliminary issues or non-issue comments or questions. A second document takes the preliminary issues and divides them into two categories, significant issues or nonsignificant issues. A third document takes the significant issues and divides them into alternatives eliminated from detailed study or action alternatives. These three documents show the progression of the comment analysis process. Comments are followed by notes by FS team members in italics.

Preliminary Issues Raised by Public

Bird (April – Response to NOI)

There are concerns from Mt. Trumbull that residual trees in a similar silvicultural-restoration application where lost to mortality. It may be that the residual tree mortality was related to the effects of prescribed burning in combination with unique soil types that resulted in irreversible damage to root systems. The FS must account for such unforeseen possibilities in the Kachina Analysis Area by completing extensive soil surveys, and identifying sensitive soil types where similar mortality might occur. Prescribed burning should be planned spatially and temporally to account for such sensitive soils. Will the ground disturbance associated with silvicultural treatments also impact these sensitive soils?

Bird (April – Response to NOI)

We are concerned that the Kachina Timber Sale will jeopardize the viability of species that thrive in forest ecosystems through activities associated with timber harvest and ground-disturbing activities intervene in natural disturbance processes that are vital to ecosystem sustainability and degrade water quality and watershed condition. There are populations of focal species and species-at-risk (MIS and TES) that occupy the analysis area and surrounding landscapes that seem to be surviving despite the "unnatural conditions" the Forest Service purports to exist. The FS is required per its 1987 LRMP as well as Federal planning regulations to collect and present information on population numbers and trends for these species as well as define what constitutes the "minimum number" of individuals of each population to secure its long-term viability. The FS must present information to support determinations that the proposed Kachina Timber Sale will not contribute to further declines in these populations and more listing under the ESA. Simply, it is too soon to know how the "treatments" at Fort Valley will affect focal species and species-at-risk.

Bird (April – Response to NOI)

The Kachina Timber Sale will also damage social and economic uses and values associated with natural forests for the benefit of the timber industry, even though non-timber uses and values are far more important to local communities.

Nowicki

A 16-inch diameter cutting cap is critical. Many sites have been commercially harvested removing a large component of the larger trees from forest structure. Existing large blackjacks will develop into the next generation of old growth. Retaining 16-inch dbh or greater provides some assurance the proposed action would not detriment this forest structure further. A 16-inch cap would not impede any of the treatments meeting the stated objectives. (Nowicki Clarification Comment) In fact, even a 12-inches dbh cutting cap would not impede the treatments from achieving the stated objectives, as a large proportion of the trees in the project are smaller than 12-inches dbh. That is, thinning treatments would be able to create a diversity of stand densities and structures by implementing varying levels of thinning the trees less than 12-inches dbh. This analysis and cutting cap is absolutely necessary to protecting vital components of the current forest structure, and the next generation of old growth that will develop in the forest.

Nowicki and Nowicki Clarification Comment

No new roads should be constructed, even if only for the duration of the project as roads greatly increase soil compaction, transport of exotic weeds, and long lasting impacts on forest structure. South of Kelly Canyon all thinning should be done by hand; the limitation would not impede any of the treatments from achieving stated objectives.

Nowicki

The EIS needs to include an analysis of the grazing allotments in this area and appropriateness of grazing in general and the deferment needed to allow ground vegetation to respond after thinning.

Metzner

Project is way too big for needs pressing. This is another move by the government to control the people's freedom of movement and grab public lands. Scope of project is way out of line for a natural forest. More controls on camping and where, not needed or wanted. We do not want more controls on people's freedoms. Leave the trails alone for the people who use them.

Bird

The proposal represents a "sledgehammer" approach to forest management, the extensive logging proposed has the potential to exacerbate fire danger, extirpate wildlife, and increase sedimentation and flooding.

Bird

The proposal forces the taxpayer to foot the bill for an enormously expensive project whose benefits are highly uncertain.

Bird

Temporary road construction will simply increase the environmental costs of the Kachina Project, increase fire hazard as they are used by ORV's and provide additional public access. The only reason the roads are needed is to remove commercial materials.

Bird and Nowicki Clarification Letter

It remains entirely unclear what purpose the 3-foot-wide dozer line along the canyon rims will serve. This construction might potentially change the hydrology of the canyon system significantly by redirecting runoff away from the canyon edges.

Do not drive cat lines through the area. For many of the reasons as listed directly above, cat lines should not be used in the area. Fire lines should be created by hand if they are absolutely necessary.

McKinnon and Ack

South of James Canyon, in areas proposed for thinning and burning, cheatgrass (*Bromus tectorum)* is a regular and often dominant understory species. We are concerned that the proposed treatments by themselves—especially burning—may facilitate its further spread and competition with native species. We strongly encourage the Forest Service to assess the need for an integrated strategy to improve, rather that potentially exacerbate the problem, both south of James Canyon and in other locals within the project area where cheatgrass poses a foreseeable risk.

The Nature Conservancy's Wildland Weeds Management and Research Program has developed the following recommendations for the management of cheatgrass. We've attached this document in its entirety as an appendix to these comments for your use.

> Lasting control of cheatgrass will require a combination of chemical control, physical control, vegetative suppression, and proper livestock management where land is grazed. This "cumulative stress" method will keep the plants constantly under stress, reducing their ability to flourish and spread. Also, a cumulative stress approach provides a level of redundancy in case one type of treatment is not implemented or proves to be ineffective.
>
> An effective management program needs first to control existing infestations, and second to develop a land management plan to deter re-infestation of Bromus tectorum. New infestations should be controlled first before cheatgrass becomes dominant and alters the soil chemistry of the area (Belnap pers. comm.). Since cheatgrass reproduces entirely by seed, the key to controlling existing infestations is to eliminate new seed production and deplete the existing seed bank.
>
> Bromus tectorum is most commonly controlled with herbicides. Quizalofop, fluazifop, sethoxydim, paraquat, glyphosate, and imazameth can be applied in the early spring, before perennial grasses have emerged, to control cheatgrass. Additionally, sulfometuron methyl, and atrazine can be applied in the fall to control cheatgrass in winter crops. Several of these herbicides may damage established perennials. Therefore, the timing of herbicide application is crucial to ensure that cheatgrass is selectively controlled. Burning is usually conducted in late May or early June, after the plants have dried (Beck, pers. comm.). Reseeding native perennial grasses is necessary after burning or cheatgrass and other weeds will simply reestablish in the disturbed area.

A two to three-year combination of burning, herbicide application, and reseeding can be used to control and re-vegetate an area that is almost exclusively dominated by cheatgrass. Burn and re-seed the area with native perennial grasses during the first year. The following spring, apply herbicides before the seeded perennial grasses emerge in order to eliminate any cheatgrass that emerged from the seedbank after the burn. If necessary, apply a second round of herbicides early in the spring of the third year to control any new cheatgrass seedlings and provide time for native bunchgrasses to establish. This should control the cheatgrass, deplete the existing cheatgrass seed bank, and provide adequate time for perennial grasses to establish to the point where they can suppress any new cheatgrass invasions.

If the area is only partially infested with cheatgrass, burning is usually not recommended (Belnap, pers. comm.). Cheatgrass can rebound quickly after a fire and the elimination of the remaining valuable species will only enhance its ability to spread.

Hand pulling cheatgrass is very labor intensive and is worthwhile only on very small infestations. Mowing and cutting are not usually recommended methods of control. Plants that are cut before seed ripening will regenerate new culms and produce seeds at the cut height. Plants that are cut after seed ripening will die, but by this point the seeds are already viable. However, repeated mowing (every three weeks) can eliminate cheatgrass seed production in areas were herbicide applications are unacceptable or cannot be safely used.

Once an area has been treated, native perennial grasses should be plugged and/or re-seeded or cheatgrass will return to pre-burn densities within a few years (Beck, pers. comm.). Hilaria (Hilaria jamesii) has been observed to grow well in cheatgrass infested areas of the Colorado Plateau by taking advantage of warm summer rains (Belnap pers. comm.).

McKinnon and Ack

The interruption of natural processes in southwestern ponderosa pine forests has been attributed to widespread intensive livestock grazing that was introduced in the mid and late 19th century. Upon introduction, livestock grazing removed the herbaceous understory that is believed to have limited pine seedling establishment and therefore also tree densities through competition for light, water, and nutrients, in addition to carrying frequent low intensity ground fires.

In the absence of this "competition fire filter" that limited pine seedling establishment, anomalously high densities of trees have established that now facilitate similarly anomalous high-intensity crown fires that threaten ecological and human values alike. In addition, the pine irruptions have led to a decline in overall biological diversity of these forest ecosystems, much of which was historically based on the understory.

Considering this, perhaps the most critical element to the restoration process for ponderosa pine forests is ensuring that we facilitate understory (grass and forb) recovery. In part this must come through control of herbivores. Of the two major herbivore pressures currently on the landscape (elk and domestic livestock), we can only directly control the intensity, seasonality, and duration of domestic livestock grazing.

We think the appropriate frame of reference for considering post-treatment (thinning and/or burning) livestock grazing begins with the assumption that the most desirable management regime—and the one that will most likely facilitate our restoration goal of understory recovery—is livestock grazing deferral for a period of time.

Based upon our observations at other restoration sites, and discussions with Forest Service personnel, we recommend this period of time span at least three growing seasons. We further recommend that quantitative and qualitative measures of recovery should inform whether, after three growing seasons, livestock should be reintroduced, and if so, at what intensity, seasonality, and duration. One measure of recovery included in this assessment should be whether the native understory is capable of carrying low-intensity grass fires.

Germaine

Item 2 *discusses retaining ponderosa trees "approximately" 150 years or older. It is not clear how and by whom decisions on these trees will be made. Similarly, this Item states that >16" trees will be "retained where possible". What criteria determine retention/removal, and who will make the decision on*

the fate of an unknown number(?) of trees in such an ecologically important size class from which our future old-growth trees are to be recruited? Finally, I urge that all road and landing locations avoid large diameter trees in all instances, not simply "where possible" as stated in the proposal. In addition to soil compaction, old landings have roads that are often traveled for years even if legally closed, and landings under old trees will unquestionably become popular (renegade) campsites.

McKinnon and Ack

We appreciate that the Forest Service has articulated that the vast majority of trees to be thinned will be less than 12 inches and that trees greater than 16-inches diameter at breast height will be retained where possible. ***However, we feel that a 16-inch cap is warranted and should be instituted in accord with the GCFP's recommendation on this project.***

Monitoring of the 16-inch cap at Ft. Valley has revealed that, even in a thinning prescription that gives little deference to tree size, only 2.5 large trees per acre would have been cut in the absence of a diameter cap. And of these trees, only 1 percent were suppressed. The vast majority, or 99 percent of the trees, were dominant or co-dominant trees. Considering the description of thinning from below in the proposed action, "thinning from below results in the removal of smaller, unhealthy trees first and progresses until the target density is reached," it's unclear why any significant reason *not* to include a diameter cap exists.

This is not to ignore the economic realities of restoration. Indeed, smaller trees are more expensive for an operator to handle. There is more handling per unit of wood volume with small trees than larger trees, rendering smaller trees more expensive to thin. If the USFS has an economic argument to make about trees larger than 16 inches, it should make that argument explicitly.

In the absence of such an argument, we believe that there are significant social and political arguments to include a diameter cap. These arguments are of immediate concern to the Grand Canyon Trust and we believe they should be of concern to the Coconino National Forest.

The history of forest management in the Southwest still casts a shadow over our current efforts. It hasn't been very long since most of the big, old trees on the forest were felled at the cost of species viability and overall ecosystem integrity. At the present time, the public perception is that cutting big trees is about revenue generation, and not about the restoration of species and ecosystems.

A 16-inch cap provides the public with a clear, easily communicated guarantee that distinguishes our restoration efforts from those historical practices that have resulted in the need for restoration today. The diameter cap is also about the restoration of public confidence and trust.

With each ensuing discussion of the merits of a diameter cap will come news stories questioning our intent and our legitimacy, using well-honed activist media techniques. These opponents are very effective at whittling away at our legitimacy and weakening public support for restoration. Do we really wish to continue subjecting our efforts to these liabilities?

Having been put in the national spotlight, we also have the responsibility and the opportunity to more clearly define the purpose of restoration by exemplifying the parameters of responsible restoration. Adopting a diameter cap establishes sideboards for restoration that prevent ill-conceived adaptations of our efforts and reinforce a principle we have identified as fundamental to responsible restoration: effective restoration will require substantial reinvestment. Restoration should not be expected to pay for itself.

Considering these points, we are confident that the original recommendation put forth in unanimous resolution by the Grand Canyon Forests Partnership provides a workable and reasonable approach to diameter caps:

> *"Ponderosa pine trees greater than 16" dbh will be retained on the land. Black-barked trees in excess of 16 inches may only be treated to achieve the desired objectives of creating grassy openings or enhancing existing forest openings, or to enhance the health of old growth stands or oak clumps. However, all of these trees will be left standing (recruited) as snags or felled and left as downed logs."*

We strongly encourage the Forest Service to include an alternative that evaluates the impacts of the above recommendation in addition to an alternative that includes and evaluates an 1-inch diameter cap. These evaluations should provide a quantitative explanation of how project objectives will be affected by these different diameter

caps, both ecologically and economically. We further suggest that these alternatives explore—perhaps with the help of Rocky Mountain Research Station social scientists—the social, political, and historical dimensions of a diameter cap in the context of ponderosa pine forest restoration in the Southwest.

Nowicki

(The following comments were provided by B. Nowicki in a July 18 and a August 16 letter from the SWFA and others (after the comments listed above). The two letters included duplicated information.)

A 16-inch diameter cutting cap is critical. Many sites have been commercially harvested removing a large component of the larger trees from forest structure. Existing large blackjacks will develop into the next generation of old growth. Retaining 16-inch dbh or greater provides some assurance the proposed action would not detriment this forest structure further. A 16-inch cap would not impede any of the treatments meeting the stated objectives.

Implement a 16-inches diameter cutting cap throughout the entire Kachina Village Project. Many of the sites within the project area have been commercially harvested, removing a large component of the larger trees from the forest structure. The existing large blackjack ponderosa pine trees will develop into the next generation of old growth in these areas. Retaining all trees with 16-inches dbh or greater would provide some assurance that the proposed action would not detriment even further those degraded forest structures. In fact, even a 12-inche dbh cutting cap would not impede the treatments from achieving the stated objectives, as a large proportion of the trees in the project are smaller than 12-inches dbh. That is, thinning treatments would be able to create a diversity of stand densities and structures by implementing varying levels of thinning the trees less than 12-inches dbh. This analysis and cutting cap is absolutely necessary to protecting vital components of the current forest structure, and the next generation of old growth that will develop in the forest.

Implement "thinning from below, north of Kelly Canyon" within the 1/8 mile (660 feet) immediately adjacent to homes. Beyond the 1/8 mile, implement a variable "thinning from below" to 60-120 BA north of Kelly Canyon. This combination of treatments acknowledges a distinction between wildland-urban interface treatment and general fuels reduction, and delineates a distinct defensible space in the wildland-urban interface. The 660-foot "Intensive Zone" provides a defensible space in which a crown fire can be forced to the ground, and in which firefighters can safely work. The less intensive treatment beyond 1/8 mile from houses serves as an extensive zone to reduce fire intensity as it approaches the community. The intensive and extensive zone treatments have been used in the Southwest in the past to protect communities from the threat of wildfire, and should be analyzed for use in this project. Such a method reduces the impact on adjacent forest ecosystems while providing community protection.

Furthermore, Forest Service research shows that the homesites themselves and the areas immediately surrounding houses are the largest factors determining whether houses are at risk of burning from forest fires. Therefore, the EIS needs to analyze the effectiveness and necessity of these treatments in conjunction with the current and future treatments implemented on the private property adjacent to the project. The EIS should also explain why there are areas immediately adjacent to the private property boundaries that are not being treated in this project. The project in its proposed form may implement high levels of forest thinning without effectively and efficiently providing wildfire protection for the adjacent communities.

No new roads should be constructed, even if only for the duration of the project as roads greatly increase soil compaction, transport of exotic weeds and long lasting impacts on forest structure. South of Kelly Canyon all thinning should be done by hand, the limitation would not impede any of the treatments from achieving stated objectives.

No new roads should be constructed for this project, even if only for the duration of the project. Roads greatly increase soil compaction, encourage the transport of exotic seeds, and have long-lasting impacts on the forest structure. The entire project area has previously been heavily impacted by recreation, including heavy traffic of ORV's, and should be spared further damage. Also, no area in the project is far enough from roads to require new roads to be built. In areas that are prohibitively far from roads, this may limit the size of trees that can be cut. However, this limitation would not impede any of the treatments from achieving the stated objectives.

Do not drive cat lines through the area. For many of the reasons as listed directly above, cat lines should

not be used in the area. Fire lines should be created by hand if they absolutely necessary.

Use only hand thinning south of Kelly Canyon. The use of hand thinning may limit the size of trees that can be cut in some areas away from roads. However, this limitation would not impede any of the treatments from achieving the stated objectives. Using hand thinning, the project will still be able to create a diversity of forest structures and densities throughout the area, including dense patches within a less dense matrix. Most importantly, the use of hand thinning would minimize the soil impacts, protecting the area from further damage, and maximizing its ability to recover and achieve the proposed objectives of forest health and wildlife habitat.

Use only hand thinning south of Kelly Canyon. One of the objectives mentioned early in the planning process was to manage the area south of Kelly Canyon for wildlife, including designating the area as old growth, existing or recruiting. This area is not near houses or communities and is a critical corridor for turkey and bear as well as generally being important wildlife habitat with the potential to develop good old growth characteristics. Designating the area as old growth would provide some protection for this area of the forest as it develops old-growth structure and function. Furthermore, the EIS should include a comprehensive analysis of old growth at the forest level as well as the project level, as required by the Forest Plan.

The use of hand thinning may limit the size of trees that can be cut in some areas away from roads. However, this limitation would not impede any of the treatments from achieving the stated objectives. Using hand thinning, the project will still be able to create a diversity of forest structures and densities throughout the area, including dense patches within a less dense matrix. Most importantly, the use of hand thinning would minimize the soil impacts, protecting the area from further damage, and maximizing its ability to recover and achieve the proposed objectives of forest health and wildlife habitat.

Nowicki Comment: The following comments were provided by B. Nowicki on 9/20 on the request of Tammy Randall-Parker. Tammy asked Brian several very specific questions to better understand exactly what some of the comments were addressing. I phoned and asked him to come in and visit, he could not. Instead he sent an additional letter, that did address the questions I had put forward to him regarding roads and my interpretation of their recommendations for the project (See PRD 110A). The following is his last e-mail.

> Ms Randall-Parker,
>
> I have not been in touch with Taylor, but I hope to speak with him soon regarding the Kachina Village Project. I assume that his lengthy comments are being considered in developing the alternatives.
>
> I will attempt to clarify, as succinctly as possible, the SWFA comments you and I spoke about yesterday regarding the Kachina Village Project. These include: the 1/8-mile treatments around communities, 60-120 BA north of Kelly Canyon, temporary roads, and hand thinning south of Kelly Canyon.
>
> 1/8-mile WUI treatments:
>
> The Forest Service researcher Jack Cohen states that the area immediately adjacent to structures (houses) is the most important determinant of whether or not that house will burn. (Many of his ideas are presented in the SWFA document "Protecting Communities from Forest Fires" that can be found on our website www.swfa.org, although I am sure that you can also access his findings directly through the Forest Service.) The ideas regarding protecting houses fit in with the concept of an intensive zone treatment. In many cases, intensive zone treatments (often a narrow band of 1/8 mile= 660 feet= 200 meters directly adjacent to communities) provide a defensible space for fighting fires as well as providing a shaded fuelbreak in which the fire can drop to the ground. The exact prescription for such an intensive zone would be highly site-dependent, and the district fire and fuels experts would have to determine them on a site-by-site basis. However, the treatment generally requires the removal of ladder fuels and a reduction of fuels loads, as well as eliminating continuous canopy so that only relatively small groups and individuals would be left. "The wildland fuel characteristics beyond the homesite have little if any significance to WUI home fire losses." (Cohen 1999). Therefore, treatment beyond the area immediately adjacent to communities (1/8-mile) should be treated with a general fuel reduction as would be used throughout the wildland forest. Of

course, no WUI treatment is effective unless the personal properties and all homesites are treated. However, used in conjunction with home treatment, the above methods can provide real community protection, while at the same time reducing the need for drastic and extensive thinning beyond the area immediately adjacent to communities.

60-120 BA North of Kelly Canyon:

Thinning to a range of 60-120 sq ft BA should provide all of the benefits that are provided by thinning to a 40-120 sq ft BA, but would provide some protection against unnecessary and overzealous thinning. The negative ecological impacts of reducing a significant portion of the forest to 40 sq ft BA could be severe. It is also my understanding that 40 sq ft BA is lower than is necessary to achieve the desired goals of increased forest health and lowered fire risk. (An analysis of the resulting crown bulk density may be most appropriate for determining the latter.) Of course, this range of BA refers only to forested acres, and not openings and meadows. Also, we would assume that the entire range of 60-120 sq ft BA would be represented, and there would not be a bias toward the low end of the range.

Temporary Road Construction:

The negative ecological impacts of road building may far outweigh the benefits gained from an increased level of thinning. Understandably, the lack of new roads may, in some cases, reduce the size of trees that may be removed from an area, thereby affecting the post-treatment stand density. However, in many cases the resulting difference may be marginal. More importantly, the desired effects of thinning may be only slightly reduced, but the negative effects of roads would be entirely eliminated. In some instances, the district may consider cutting trees even though the logs could not be removed by road. In these cases, the logs may be lopped or bucked and eventually consumed by prescribed fire. Of course, in some cases, such methods would create very high fuel loads for the first prescribed fires. In such cases, the district could consider thinning over a series of years, with a series of prescribed fires. Furthermore, the district should analyze the need for roads in each stand, not just the need for them overall.

Hand-thinning South of Kelly Canyon:

Use of hand-thinning in the area south of Kelly Canyon may restrict the cutting cap to 9"dbh. However, thinning with a 9" cap can achieve the goals of the projects. At the same time, the area will be spared the severe impacts of soil compaction and disturbance by large machines. The costs of such soil impacts may far outweigh the ecological costs of leaving a higher tree density on the site.

SWFA expects the Peaks Ranger District to perform a fair and thorough analysis of these issues. Please do not analyze these issues in such a way as to determine, for example, whether a 9" cap will allow you to reach you goal of 40 BA. Obviously, this is circular reasoning and unfair. Rather, analyze whether a 9" cap will allow you to achieve the goals of fire risk reduction and forest health. Present your findings not by simply saying, for example, that one alternative provides greater fire risk reduction than another. Instead, please present your findings as a quantitative result, such as "Alternative X provides only 80% as much increased tree growth as Alternative Y", or "Alternative X will carry a continuous crown fire at 50 mph, whereas Alternative Y will carry one at 60 mph". Presenting the findings as such will allow us to consider the proportional difference in benefits compared to the differences in treatment and collateral damage (such as roads).

Thank you very much for considering these ideas. Please feel free to call me if you have any further questions.

Brian Nowicki

Non-Issues Comments and Questions

These items did not meet the definition for an issue defined as a **dispute or disagreement** with the **Proposed Action** based on some **anticipated environmental effect**.

Bird (April – NOI response)

We intend this letter to be an expression of our interest in the Kachina Timber Sale. Our organiza-

tions, FCC and NFPA would like to raise several issues concerning the project that should be addressed in subsequent environmental documentation.

Non-Issue: *It is stated there are issues, but no anticipated affects identified.*

Response: *The project is not a timber sale. In the future, reference this project as the Kachina Village Forest Health Project. This project has not been planned as a timber sale, note that "timber production" is not listed in the purpose and need section of the Proposed Action.*

Bird (April – Response to NOI)

The systematic application of an unproven silvicultural restoration technique being applied to thousands of acres around Flagstaff and requires a programmatic EIS (PEIS) remains a grave concern of our organizations. During the Ft. Valley NEPA and legal proceedings, the Forest Service argued that a PEIS and a legally compliant cumulative effects analysis were not necessary because the experimental nature of the various treatments in Fort Valley precluded knowledge of what types of actions might be applied to remaining 90K+/- acres remaining in the Flagstaff area. Despite its assurances, the Forest Service is proposing to employ one or more of the Ft. Valley-type activities in the Kachina 10K! It is plainly time for the Forest Service to concede that it has well-defined plans for 100 thousand acres surrounding Flagstaff and to proceed with a PEIS and the appropriate cumulative effect analysis.

Non-Issue: *This comment poses no dispute or disagreement with the Proposed Action, rather there is a disagreement with the Fort Valley Project. No anticipated effects are directed at the Proposed Action.*

Response: *Your request for a Programmatic Environmental Assessment and subsequent description of this is unsubstantiated by factual information. Nowhere in the Fort Valley Project Record File have your organizations ever mentioned a request for a PEIS. There is no mention of a PEIS anywhere in the CFR regulations or FS manual direction. There is no such thing as a PEIS, so we are having difficulty understanding this request.*

Legal proceedings on Fort Valley had nothing to do with a PEIS or cumulative effects; the legal proceedings focused on a process related issue that your groups brought forward. The process issue centered on a comment period for the EA for Fort Valley.

The Kachina Village Forest Health Project will be conducted according to all Federal regulations at stated in the CFR's as we proceed with NEPA on this project. The Kachina Village Forest Health Project is a site-specific project for an area south of Kachina Village. Site-specific projects as required by NEPA require the preparation of a CE, EA or EIS. The Coconino National Forest Land Management Plan and subsequent amendment will guide this project. Cumulative effects for ongoing, past and foreseeable future projects will be analyzed.

Bird (April – Response to NOI)

The question of uncertainty and the principle of adaptive management is still at the forefront of the controversy surrounding the GCFP/Forest Service approach to forest restoration. The FS and GCFP have adamantly insisted the nature of the thinning is experimental in nature, thus accurate prediction of effects cannot be made, and no future timber sales would go forward until scientific information validating one or another of treatments becomes available. More large-scale restoration timber sales such as Kachina is exactly what our organizations warned of Ft. Valley. The actions at Fort Valley have not even commenced in full and planning for another 10K has started. Such blatant failure to stand by the principles of adaptive management is exactly what has eroded the public's faith in the FS.

Non-Issue: *There is a dispute with the Fort Valley Project, but no disagreement with the proposed action. There are no anticipated effects stated by the respondent with the Proposed Action.*

Response: *The project is not a timber sale. The FS has not adamantly insisted the nature of the thinning is experimental in nature and has not stated we could not make accurate effects analysis. The FS has never stated future projects would not be analyzed while we wait for research data collected at Fort Valley. We are pleased to see the Fort Valley Project move forward and we will learn new information from the project. There are no experimental treatments proposed for Kachina Village; all silvicultural treatments have been proposed in the past and studied and fall within parameters of the Forest Plan. The thinning south of Kelly Canyon with the deferment patches is a "new approach" to a straight thinning from below with the deferral patches maintained for wildlife. Arizona Game and Fish biologists have worked with the IDT in the design of this treatment and are anxious to see it applied on the ground. In fact we have received three letters from the Arizona Game and Fish Department in support of the treatment and overall design of this project.*

Bird (April – Response to NOI)

The structural model applied at Ft. Valley and we assume the GCFP is attempting to blindly apply again to public forest is fraught with uncertainty and has not produced information, other than anecdotal support of silvicultural goals. The Covington model is based on structural attributes of ponderosa pine forests and supporting evidence consists of research on residual tree characteristics, ie. dbh, growth related variable. This is not appropriate for our Federal public forestlands, which are important ecological concentrations for TES species population trends and habitat occupancy, hydrological processes, soils, etc.

Non-Issue: *There is no disagreement or dispute related to the Proposed Action and there are no anticipated effects stated with the Proposed Action. Rather, the respondent has issues with the Ft. Valley Project and the Covington model of restoration.*

Response: *The Kachina Village Forest Health Project Proposed Action does not include any Covington model restoration type prescriptions and is working with existing structure.*

Bird (April –Response to NOI)

The FS during Fort Valley was criticized for using selective science or ignoring critical science that pointed to the uncertainties involved in silviculture-bases restoration and fuels management. The new National Forest Management Act planning regulations became effective on November 9, 2000. The regulations mandate that the restoration and maintenance of ecological sustainability is the "first priority for stewardship of the national forests." (36 C.F.R. 219). The FS is now required to ensure "that the best available science is considered in planning." In particular, the requirement to consider the best available science applies immediately to all project decisions implementing current forest plans. FS must refer to all of literature and science available. There is little to no empirical evidence that the proposed activities reduce fire risk or behavior and in fact, the evidence would lead to the opposite conclusion that commercial timbering and thinning actually will increase the immediate risk of stand-replacing fire or unnatural fire conditions and old growth structure and process. In the recent Science Consistency Check for the Sierra Nevada Forest Plan Amendment, the science team repeatedly makes this point. (Final Report from the Science Consistency Check Team on the Carson Nevada Forest Plan Amendment, 2000). Creating large trees is a silvicultural goal, not a purely ecological goal: big trees alone do not ensure old growth conditions and processes.

Non-Issue*: There is no dispute or disagreement with the Proposed Action and there are no anticipated affects stated with the Proposed Action.*

Response: *The new planning regulations will not be used for this analysis as these regulations are on hold at this time. Our IDT will use all existing information available and scientific information to conduct the best effects analysis possible.*

Bird (April – Response to NOI)

The FS must justify the application of potentially harmful actions across 9,000 acres of Federal forest lands rather than focusing its efforts on reducing the immediate risk to property and lives in the WUI and a property owner education and cooperation program. Congress has not approved widespread timber sales miles from the WUI. The Coconino National Forest nor the GCFP has defined the WUI. The Kachina EIS must offer legitimate justification for applying silviculturual treatments to thousand of acres of remote forestlands outside the WUI. Is this cost effective? What the short and long-term ecological implications? What are the short and long-term costs for maintaining the 10K landscape in the "desired" condition?

Non Issue*: This comment is not specific to the Proposed Action, however there are several comments which are addressed as follows.*

Response: *For the City of Flagstaff and surrounding satellite communities, the Forest Service has had a definition of the wildland-urban interface in the Coconino Land Management Plan and a map of the interface that has been in use for years. The Fire Management Area Zone (FMAZ) map shows that all but a small area south of James Canyon are within the W/UI. In the Coconino LMP there is guidance on the size and scale of the urban interface found on page 93, the Plan states "the urban interface is defined as an area up to 10 miles long in a south-westerly direction from urban areas."*

Fire managers in Flagstaff have defined the WUI as the points from which a fire originating under average worst case conditions that would be likely to reach structures within one or two burning periods. For example, a fire that started near the junction of Highway 89 and Forest Service Road 237 could easily travel the approximately 3 miles to the south

end of Kachina Village within one burning period. A fire in this area (as shown with Farsite Modeling PRD 73) will travel 2.5 to 3 miles in one afternoon, thereby prompting us to look at the entire area in order to protect homes in Forest Highlands and Kachina Village. This type of fire would likely overwhelm initial attack firefighters.

Further, this project proposal is not just a WUI proposal. It is clearly stated in the Proposed Action as a project to improve declining forest health and high fire hazard conditions. MSO PAC's, old-growth habitats, old trees, northern goshawk habitat, cultural sites, and the Oak Creek watershed are at risk from wildfire and management actions are proposed to reduce wildfire risk and potential.

The questions described in this comment will be addressed in the EIS. A cumulative effects analysis will be prepared. FSH indicates that economics are not important drivers in this project. Commodity production is not the driving factor in this project; forest health improvement is. Therefore, cost effectiveness is not the prime question here. "For purposes of complying with the (National Environmental Policy) Act, the weighing of merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations. (Emphasis added) (FSH 1909.15 41.1(2); FSH 1909.15 22.35; 40 CFR 1502.23. FSM 1905-55 defines "net public benefits" as "an expression used to signify the overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria rather than a single measure or index." This definition is consistent with the direction of complying with NEPA.

Bird (April – Response to NOI)

We are concerned with the adverse economic effects of commercial logging, including silviculture-based restoration on public lands and the damage and loss of ecosystem service values associated with standing or otherwise intact forests. The FS failure to quantify such effects at the project level or for the logging program as a whole is contrary to many Federal and USFS regulations. The opportunity costs of logging, which include the values, of uses forgone on areas logged plus the benefits associated with alternative uses of timber sale funds should be evaluated on a project basis. We request an impartial analysis of all values, both market and not-market associated with each alternative including the non-action and no commercial harvest alternatives. This includes employment and income (including multipliers) associated with non-timber uses.

Non-Issue: *There is disagreement expressed with the Forest Service in general, but no disagreement with the Proposed Action and no anticipated affects stated with the Proposed Action.*

Response: *The Forest Service will conduct an economic evaluation of the alternatives in the Draft EIS. An economic analysis will comply with manual direction for this item.*

Bird (April – Response to NOI)

The analysis needs to include an indepth treatment of cumulative effects, especially in regards to soils, water quality, fragmentation, old growth, TES, MIS and neotropical migrant birds. All activities including past, present, and reasonably foreseeable future activities, including the application of silvicultural restoration treatments to 100K acres in the Flagstaff area, on each and every land ownership must be incorporated. This is important considering the fact that the FS is ignoring its promises to not apply these experimental treatments until information about their effectiveness can be obtained from other areas and the obvious intentions of the FS to apply these treatments to many 10K units as quickly as possible.

Non-Issue: *There is no disagreement stated with the Proposed Action and no anticipated effects stated with actions for the Proposed Action.*

Response: *The Draft EIS for the Kachina Village Forest Health Project will include a cumulative effects analysis as directed by Federal regulations which includes ongoing, past and foreseeable future projects (as defined as a project with a proposed action).*

Bird

Statement concerning prioritization of implementation "by treating stands adjacent to communities first, and then progressing south thereafter" makes no sense and seems to pay lip service to the national direction and science on WUI forest treatments and places no concrete limitation on the project.

Non-Issue*: No stated specific effect.*

Response: *As the treatments are implemented within the project area, the treatments north of Kelly Canyon will come first. The areas closest to the*

urban interface were prioritized, as first to complete important work needed in the highest fire risk areas. Treatments proposed south of Kelly Canyon will begin after the north half is complete. Fire occurrence data shows areas north of Kelly Canyon to have more frequent human starts with higher use occurring north of Kelly Canyon.

Denton

Large dense stands will continue to maintain a threat of disturbance events including stand replacement, fire, insects, disease and drought.

Non-Issue: *No disagreement with the Proposed Action.*

Response: *A phone call to Charlie Denton was made to clarify this issue. Charlie is not concerned with the Proposed Action, if deferral patches remain as stated in the Proposed Action which is 1/10th to 1 acre. However, there would be concerns if deferral patches become larger than 2 acres in size or there are additional leave areas proposed, say more than the 25 percent described in the Proposed Action. We have a concern with leaving large dense areas as well and have brought forward a Proposed Action which will not leave large dense areas susceptible to fire, insects and disease.*

Denton

The proposed actions do not bring the ecosystem within the range of evolutionary (natural) variability, which is needed to allow natural fire to play a role.

Non-Issue: *No specific disagreement with the Proposed Action.*

Response: *This is not an issue with Charlie per phone call. He does not believe natural fire should be included in the Proposed Action, which it is not. Charlie has concerns with smoke management and social acceptance, and is not supportive of the use of "natural fire" in the urban interface. He also believes the dense patches would affect our ability to use natural fire in the area.*

The objective to allow natural fire to play a role in this area is beyond the scope of this project. The Forest Service IDT and public participants discussed this as a possible objective for the project, however this was dropped for several reasons including public acceptance, smoke management concerns, etc.

Denton

No actions are described which increase the diversity of age classes.

Non-Issue: *No specific disagreement with the Proposed Action.*

Response: *Per the phone call, Charlie stated we cannot change the diversity of age classes—and does not think this should be part of purpose and need. He agrees we are improving and increasing the diversity of diameter classes. Charlie is not advocating for regeneration treatments, and is concerned about increasing the number of small trees as this would affect fire potential. He stated we need to followup with future broadcast burning to thin regeneration areas that will result from our thinning. We agree with Charlie that future broadcast burns and maintenance burning is essential to managing regeneration in the area.*

Denton

The understory productivity and diversity will only respond in those areas where significant overstory and understory thinning occurs.

Non-Issue: *No dispute stated or disagreement with the Proposed Action.*

Response: *The Forest Service is aware of research and studies which document the effects of understory response to stand density The changes in understory development will be described in the EIS.*

Denton

Smoke management will be a restrictive item adjacent to the interface property.

Non-Issue*: No dispute stated or disagreement with the Proposed Action.*

Response: *True statement; no disagreement from the team.*

Pond

The Highlands Fire Department thanks the Forest Service and Partnership for excellent work on the project. Appreciate participation in the initial planning. In favor of efforts (thinning, burning) and other efforts to reduce the potential for large fires in the Wildland Urban Interface. We would like to remain active in the processes of this project and we are willing to serve as a community source of information regarding this project.

***Non-Issue**: No dispute or disagreement with the Proposed Action.*

***Response:** The USFS intends to further communication and informational meetings with residents and local groups concerned with the project, and will continue to include and seek assistance from the fire department.*

Pond

The Highlands Fire District would like to see the project implemented sooner than the stated 5 to 10-year schedule.

***Non-Issue**: There is a dispute with the Proposed Action, but no anticipated effects are stated by the respondent.*

***Response:** This is our best estimate for the timeline for this project. We expect that the thinning could be completed over a 3 to 4-year period. Broadcast burning would follow and will most likely take 10 years to complete all acres. In subsequent years maintenance burning will occur. This is based on past experience in managing airshed regulations, weather conditions, etc. The project will start adjacent to Kachina Village and Forest Highlands.*

Nowicki

It is my understanding the GCFP has adopted a 16-inch dbh cutting cap; the GCFP decided that any tree cut over 16 incheswould be left on site as a snag or log. However, neither made it into the Proposed Action.

***Non-Issue**: No dispute or disagreement with the Proposed Action, and no anticipated effects identified. Comments merely raise questions that can be answered now.*

***Response:** The GCFP has not adopted a 16-inch dbh cutting cap, but makes recommendations to the Forest Service on a case-by-case basis regarding a cap. The GCFP did not recommend a 16-inch cutting cap for this project but did recommend that any 16 inch tree that was targeted for removal to meet project objectives be retained on site. This was killing the tree to create a snag or felling it to become a log. The Forest Service proposed action includes creation of logs and snags. See Page 2 (Item 2) and Page 7 (Item 17) in the Kachina Village Forest Health Project Scoping Letter.*

Nowicki

If recommendations were indeed submitted by the Partnership but not accepted by the Forest Service, then this calls into serious question the reinvention laboratory status of the Grand Canyon Forests Partnership projects.

***Non-Issue:** No disagreement or dispute with the Proposed Action.*

***Response:** The Forest Service is responsible for the NEPA process, including the decision. The Partnership provides recommendations and works with the Forest Service just like all other publics can provide comment. This does not question the reinvention laboratory status of the project.*

Nowicki

The Kachina Village project should retain all trees older than 100 years to protect trees that were alive at the turn of the last century, prior to the majority of logging and grazing and before the regeneration boom of 1910.

Nowicki and Bird

The proposal poses to cut trees as much as 150 years old. This age appears to be completely arbitrary.

Nowicki Clarification Comments

Perform a field analysis of tree age to diameter for ponderosa pines, and retain all ponderosa pines older than 100 years old. This would protect trees that were alive at the turn of the last century, prior to the majority of logging and grazing, and before the regeneration boom of the late 1910's. The age limit of 150 years that is noted in the Proposed Action is arbitrary and older than all age limits used previously in the Flagstaff area. The EIS needs to include a detailed, quantitative analysis for choosing the age limit of 150 years. Of course, the retention of all ponderosa pines older than 100 years does not imply in any way that all trees younger than 100 years would be cut. This analysis and protection is absolutely necessary to protecting the next generation of old growth that will develop in the forest.

***Non-Issue** (Previous three comments): No clear disagreement expressed with the Proposed Action, no effects identified relative to the proposal; comment raises a question that can be answered now.*

Response: *Our intent is to protect all old trees in the Proposed action. Old trees are those which are "yellow-barked" and are important for wildlife species (over 80 species of wildlife use them for nesting, roosting, and feeding). The Kachina Village Forest Health Project Proposed Action states "retain all existing mature ponderosa pine trees or old 'yellow-barked' trees that are approximately 150 years old or older." The 150-year-old descriptive is merely meant to help explain "yellow-barked trees" and not meant as any management intent. Our intent is exactly the opposite—to thin from below and remove mostly smaller, younger blackjack pine as needed to meet density objectives and leave the larger, mature (yellow-barked) trees. The 150 years number actually comes from a publication by Will Moir and Jack Dieterich ("Old-Growth Ponderosa Pine from Succession In Pine-Bunchgrass Forests In Arizona and New Mexico") published in the Natural Areas Journal, Volume 8 (1), 1988 in which they define yellow pine as: "trees > 30 cm dbh but generally more than 150 years old (age at dbh)." Our personal experience suggests that the age of yellow pines can be quite variable, as few as 130 years up to 180 years or more, depending on site and density conditions, however the age is irrelevant. We are not cutting any yellow-barked trees.*

Nowicki

The Proposed Action confuses the distinction between WUI treatments and general fuels reduction. It does not delineate a distinct defensible space in the WUI, and forest areas directly adjacent to Forest Highlands and Kachina Village are not being treated for fuels reduction. The project relies on fuels treatments over a large area to provide community protection. This approach is leading to confused objectives throughout wildland forest. The SWFA endorses WUI treatments within a 660-foot WUI intensive zone (directly adjacent) to houses. South of Kelly Canyon treatments should only remove understory trees 12 inches and less to protect existing yellow pines.

Non-Issue*: No clear disagreement with the Proposed Action; the respondent finds the Proposed Action confusing. The statements bring forward no anticipated effects relative to the proposal. The comment raises questions which can be addressed now.*

Response: *The Proposed Action describes management actions to address declining, poor forest health, and high fire hazard conditions on national norest nands. Our objectives are not confused, the purpose and need section of the Proposed Action clearly defines our objectives for this project, with WUI protection being only one of fourteen objectives for the project. All lands adjacent to Forest Highlands and Kachina Village that are in need of treatment to address declining forest health and reduce high fire hazard are proposed for treatment. A fire in this area (as shown with Farsite Modeling PRD 73) will easily travel 2.5 to 3 miles in one afternoon, thereby prompting us to look at the entire area in order to protect MSO PAC's, old-growth habitats, old trees, northern goshawk habitat, cultural sites, the Oak Creek watershed and homes in Forest Highlands and Kachina Village. Direction in the Coconino LMP provides guidance on the size and scale of the urban interface. Page 93 of the Coconino LMP defines the urban interface as an area up to 10 miles long in a southwesterly direction from urban areas. Lyle Laverty (Title), as well as many other Forest Service fire specialists, believe wildland fire treatment to go far beyond the 660 feet as expressed in your comments (PRD 91B).*

Nowicki and Bird

Proposed thinning prescriptions are vague; various items are listed to be included in the EIS. Impacts are vague.

Non-Issue*: No disagreement with the Proposed Action stated and no anticipated effects provided by respondent.*

Response: *There are no impacts stated in the Proposed Action. The EIS and biological assessment and evaluation will include additional detail and effects analysis.*

Nowicki

Areas South of Kelly Canyon should be designated as old growth—existing and recruitment for wildlife habitat. The EIS needs to include a comprehensive analysis of old growth at the forest level, project level as required by the Forest Plan.

Nowicki Clarification Letter

One of the objectives mentioned early in the planning process was to manage the area south of Kelly Canyon for wildlife, including designating the area as old growth, existing or recruiting. This area is not near houses or communities and is a critical corridor for turkey and bear as well as generally being important wildlife habitat with the potential to develop good, old-growth characteristics. Designating the area as old growth would provide some protection for this area of the forest as it develops old-growth structure and function.

***Non-Issue**: No disagreement or dispute with the Proposed Action based on anticipated effects.*

***Response:** Effects on old growth and appropriate designations will be disclosed in the Draft EIS.*

Nowicki Clarification Letter

Provide a definition of "opening," including the criteria used to determine the location, size and number of openings. The EIS needs to provide clarification on the determination of openings. For example, if the project includes recreating historic openings, specify whether these are areas that have at any point in time been openings, or if they were openings prior to 1900 or some other criteria. One concern is that areas that were opened in the past by logging will be considered historic openings. Another concern is that areas that were historically more open (had very low tree densities) may have still contained some trees (trees scattered within openings). The EIS should include a justification for the management of 10 percent of the area to provide for grassy openings in the "thinning from below, north of Kelly Canyon." Is this an attempt to implement the Goshawk Guidelines throughout the area? Primarily, this analysis should determine the "historic" level of openings, by number, size, and locations. Without this clarification and analysis of the openings, the project is in danger of arbitrarily creating holes in the forest structure, with little understanding of the impact and long-term effects of such action. Furthermore, the EIS should include a quantitative analysis of the impact of the created openings. This includes analyses of the number of trees removed by diameter class, and the pre-treatment densities of those areas in which openings will be created, as well as an analysis of the number and size of openings by treatment.

***Non-Issue:** The respondent does not state a clear debate or disagreement with the Proposed Action,but rather asks questions which can be addressed at this time.*

***Response:** As stated in the Proposed Action, the selection of areas for creating grassy openings will be a combination of building on existing openings and looking at historic openings. These openings will implement the goshawk guidelines and provide gaps in the canopy to lessen crown fire potential. The Proposed Action specifies we will work to create 10 percent grassy openings in the project area. The respondent provides no anticipated environmental effects of concern for creating the openings. The need for grassy openings is well documented in the Management Recommendations in the Southwestern United States for the Northern Goshawk, Reynolds et.al. Our Forest Plan has standards and guidelines for creating grassy openings on the landscape. There is no rationale provided by the respondent for the data he requests. In my phone conversations with Brian, I mentioned the need for removal of large diameter black jacks to make grassy openings. The 1919 seed year deposited seeds in existing over-grazed small meadows. The trees which established in some of the meadows tend to be large diameter, short in height and have many limbs with abundant needle cover (full canopy). The tree form growing in many historic openings are affecting understory ground cover by shading out the understory.*

Nowicki Clarification Letter

These and the previous comments are specific to the Kachina Village Project and are not template in form. The comments were submitted in a good faith attempt to convey our concerns, issues, and objections concerning the Kachina Village Project to the Forest Service, as early as possible in the NEPA process.

We submit these comments as substantive issues to be analyzed and included within alternatives in the EIS. These clarifications follow the comments of Ms Randall-Parker at the August Grand Canyon Forests Partnership meeting, in which she stated that no substantive issues were raised in the comments so far. If the Forest Service maintains this position, please provide a citation to a provision within the NEPA, its CEQ implementing regulations, the Forest Service Manual or Handbook, or any other law or policy in support of this position.

Regardless of which issues within our scoping letter are deemed "significant" by the Forest Service, the agency is required to provide a response to our comments. See 40 C.F.R. § 1503.4. Additionally, implementing regulations at 40 C.F.R. § 1501.7 requires that even those issues not found to be significant must be identified and for the action agency to give a "brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere." Finally, in general, NEPA requires agencies to "make diligent efforts to involve the public in preparing and implementing their NEPA procedures." See 40 C.F.R. § 1506.6.

***Non-Issue:** No dispute with the Proposed Action or anticipated effects. The respondent is concerned about how their scoping comments will be addressed.*

Response: *All scoping comments have been addressed in the scoping comment summary which lists all substantive scoping comments and links each comment to its source. The scoping comment summary compiles all comments into categories: Issues; Non-Issue Comments and Questions; and Alternatives Suggested by the Public. In the scoping comment summary, all comments are addressed with a response. A definition for comments and issues is provided in the summary. The list provides transition from public scoping to the issue management phase of NEPA. A document summarizing issues and non-significant issues has been prepared. This document addresses all issues with a response as well. All of the comments, issues and alternatives suggested by this respondent have been addressed and considered by the IDT and most importantly have been reviewed by the line officer who will make this decision.*

Kennedy

The AZG&F Department supports the Forest Service management emphasis and focus on forest restoration and reducing risk of uncontrolled wildfires, and request direct involvement through Rick Miller to ensure wildlife goals and objectives are met.

Non-Issue*: No disagreement or dispute with the Proposed Action.*

Kennedy

We would like to work cooperatively with the Forest Service and GCFP to discuss possible development of pre- and post project-monitoring actions to collect information that could be used during the development of future forest health projects.

Non-Issue: *No disagreement or dispute with the Proposed Action.*

Response: *Continue to coordinate with AZG&F personnel on the project. Have draft EIS include potential preliminary research and monitoring.*

Dodd

Pleased to see Proposed Action is encouraging research and monitoring. Priority for evaluation is the two prominent treatments north of Kelly Canyon and south of Kelly Canyon. Needs 2+ years pretreatment and 2+ years post treatment.

Non-Issue*: No dispute with the Proposed Action.*

Response: *Send letter to Dodd and others to have working meeting to discuss the research. Work with AZG&F on potential funding. Include Carl Edminster and Diane Vosick of ERI & B. Cottam.*

Metzner

Thinning around housing makes sense, but should extend no more than 1/2 mile in any direction.

Non-Issue*: There is a dispute with the Proposed Action, however, no effects anticipated are described by the respondent.*

Response: *A fire in this area (as shown with Farsite Modeling PRD 73) will easily travel 2.5 to 3 miles in one afternoon, thereby prompting us to look at the entire area in order to protect MSO PAC's, old-growth habitats, old trees, northern goshawk habitat, cultural sites,the Oak Creek watershed and homes in Forest Highlands and Kachina Village. Direction in the Coconino LMP provides guidance on the size and scale of the urban interface. Page 93 of the Coconino LMP defines the urban interface as an area up to 10 miles long in a southwesterly direction from urban areas. Lyle Laverty (Title), as well as many other Forest Service fire specialists believe wildland fire treatment to go far beyond the 1/2 mile as expressed in your comments (PRD 91b).*

Metzner

If Kachina Village wants these kinds of changes in our forest, we will request it.

Non-Issue*: There is an overall dispute with bringing forward a proposal for the area, but no anticipated effects expressed.*

Response: *Many in the Kachina Village area have expressed support for the types of activities brought forward in the Proposed Action and requested these types of changes as we have heard when working on other projects such as the Lake Mary Ecosystem Management Assessment and during the open house for this project.*

Bird

FCC and NFPA remain gravely concerned that the FS continues to ignore own science, controversy of forest restoration logging and cumulative effects.

Non-Issue*: There is no clear dispute with the Proposed Action and there are no anticipated effects described.*

Bird

The Kachina Timber Sale will "encourage research and monitoring" is confusing. All of the topics or "research studies" are already being studied at Fort Valley. Wait for the results from Fort Valley before you rush headlong into another controversial and experimental restoration logging project. Agency should proceed with far greater humility.

Non-Issue: *There is clarification that is needed for the respondent. There is no clear disagreement with this Proposed Action and there are no anticipated effects provided.*

Response: *This project is not a timber sale. The treatments proposed for Kachina Village are being applied differently than those at Fort Valley and some are different than other treatments we have proposed for other projects. However, all treatments fall within the parameters of the Coconino National Forest Plan. The treatments south of Kelly Canyon, which will include the deferment areas intermixed within treatments, have not had any type of intensive wildlife study. The AZ Game and Fish Research Branch is very interested in looking at how these typeof treatments will affect Abert squirrel, songbirds and mule deer. Also, there is interest from MSO researchers to include the MSO PAC(s) within the project area as part of a regional review of the application of treatments described in the recovery plan for this species. Fort Valley did not include any thinning or prescribed burning in MSO PAC's.*

Bird

Kachina Timber Sale DEIS must comply with the 1996 LRMP amendments including providing old growth assessments at three spatial levels.

Non-Issue: *There is no dispute or disagreement with the Proposed Action.*

Response: *This Environmental Impact Statement and Project Record will have information that documents compliance with the Coconino LMP and amendments.*

McKinnon and Ack

Mechanical piling and burning piles may be ideal from a fire management perspective but it is not proven as the best alternative for ecological restoration. This approach to slash can have significant impacts on the ground. ***We believe the USFS should look at having different zones for slash management, and utilize the lop and scatter technique wherever possible,*** especially in the parts of the project area distant from structures, such as south of Kelly Canyon.

Non-Issue*: There is a dispute with the Proposed Action but no description of the anticipated effects.*

Response: *Most of the area will be rough piled with some material retained as stated in the Proposed Action. The amount of slash generated from the proposed treatments would not allow for lop and scatter only. Our experience from recent thinning activities at both the A1 and Fort Valley Ecosystem Restoration Projects have demonstrated that the slash produced will require piling. Fuels specialists have made recommendations for slash treatment that are conducive to the amount of slash created and concerns with red slash in the urban interface.*

McKinnon and Ack

We enthusiastically support the Kachina Village Project and appreciate the time and energy you and other Coconino National Forest staff have dedicated toward this project to date. In addition to comments made by the Grand Canyon Forests Partnership, we are providing the following comments that we feel could help to clarify and improve the Proposed Action for Kachina Village.

Non-Issue: *There is no dispute or disagreement with the Proposed Action.*

Response: *Thank you for your support.*

McKinnon and Ack

While this section is at the end of the document, we feel it should be the first section in a draft EIS. It is important to immediately explain "why" to the reader. We support all the statements in this section, but we are curious why the term "restoration" does not appear here or in the remainder of the document. For the Kachina project, it seems that "improving forest health" has replaced "restoring forest ecosystems" or "ecological restoration" throughout the Proposed Action.

We would like you to consider changing the name of the project to "Kachina Village Ecosystem Restoration Project," making it analogous to Fort Valley. This would also better reflect the reality of the Grand Canyon Forests Partnership as stated in the Cooperative Agreement (1998) and Guide to the Grand Canyon Forests Partnership (1998).

We also recommend replacing the #14 in purpose and need with the original language from the Guide to the Grand Canyon Forests Partnership: "Research, test, develop, and demonstrate key ecological, economic, and social dimensions of restoration efforts."

Non-Issue: *This comment has brought forward suggestions for language changes to the Proposed Action. There are, however, no anticipated environmental effects.*

Response: *The suggested language changes have been noted.*

McKinnon and Ack

In order to more accurately communicate our collective intention to retain all yellow pines in this project; and to reduce the probability that our collective efforts could be misconstrued or misunderstood, we suggest that the statement mentioning retention of trees greater than 150 years old be changed to simply state that "all yellow pines will be retained."

Non-Issue: *There is a debate with the Proposed Action regarding wording, however, there is no anticipated affect.*

Response: *The age of 150 years was a descriptive term only. This clarification will be made in the EIS.*

Mckinnon and Ack

In addition to those research institutions mentioned in the proposed action, we encourage the Forest Service to include a monitoring plan in the scope of work for this project.

Non-Issue: *There is no dispute or disagreement with the Proposed Action.*

Response: *A monitoring and implementation plan will be included in the Draft EIS.*

McKinnon and Ack

Project maps indicate that within units to be thinned, all acreage has been included for thinning targets. Based upon the experience at Ft. Valley, where thinning targets exceeded actual thinned acres, we recommend that the Forest Service reduce acres treated in each unit by a percentage in order to accommodate subsequent deferrals that are identified, or to accommodate not thinning in areas where no thinning is needed to meet project objectives.

Non-Issue: *There is no stated disagreement with the Proposed Action and no anticipated effects identified.*

Response: *This comment reflects a concern that acreages show deferral acres. The EIS will include accurate acreages.*

McKinnon and Ack

See comment #6. If thinning is proposed in areas that have been thinned in the last 10 years, the Proposed Action should identify and discuss these. Where the proposed action states that "clumps will be selected based on existing structure," it would be useful to explain this further. We recommend the following: "clumps will be selected based on the best existing structures. This includes retaining those clumps with the most and largest trees and those that have a well developed and intact group canopy structure first."

Also, the Proposed Action is unclear as to how large or small of an area over which basal area targets are to be averaged. Without this information, the capacity to actually work from the existing structure is unclear. If these targets are point specific, they will be unattainable in many cases. We recommend including minimum acreage value that adds clarity to the basal area targets.

Non-Issue: *There is no clear dispute with the Proposed Action and no anticipated affects are identified.*

Response: *The historical thinning in the area will be considered in a cumulative effects analysis. The leave clumps as stated in the Proposed Action will range in size from 1/10th acre to 1 acre. The range in size of patches thinned to different basal areas will be variable dependent upon existing stand structure and based on experience working with thinning below prescriptions pockets of thinning will vary between 1/10th to 4 acres.*

McKinnon and Ack

See comment number 6. We applaud the idea of retaining a percentage in dense groups based upon the best tree groups that exist on the landscape today. We think the description of how these areas will be identified, and how much of the total thinned area will be retained in these groups could be clarified. Rather than using the term "up to 25 percent of the area," we recommend—for specificity sake—that a range of percentage of area be identified to be left in dense groups. We recommend this range to be 15 to 25 percent of the thinned matrix.

Following are guidelines for your consideration in how these dense patches may be identified:

Identifying and deferring some patches from thinning treatment would (1) prevent unnecessary thinning applications, (2) minimize short-term disturbance during implementation, (3) maintain patches of undisturbed soil, (4) maintain patches of undisturbed canopy for dense canopy dependent species such as Abert squirrel and passerine birds and (5) reduce overall visual impacts (screening) of thinning across the entire treatment area.

It should be noted that there is considerable uncertainty about how deferral patches should be retained. Because communities are composed of different complexes of species that respond to patch size, configuration, and shape in different ways, it seems unlikely that any single set of general, theoretically derived principles would successfully predict the "best" management strategy for a particular set of circumstances (McCoy 1982, Haila 1985, 1986, Zimmerman and Bierregaard 1986). However considering that our conservation needs are immediate, and the research needed to aptly and precisely inform the management of habitat patches is largely speculative in a disturbance matrix, the general principles of restoration ecology provide a valuable framework for reaching these decisions: The general guidelines below employ existing forest structure ("deferred") according to the natural range of variability and deferral guidelines developed for similar projects.

The "patch" defined: In this case, "patch" is synonymous with "clump" as it describes a localized and distinct aggregation of ponderosa pine trees with frequently interlocking crowns and some age and/or size variation.

Patch size: Defining optimal patch sizes for deferral based upon species' needs would be an infinitely complex and under-informed undertaking. Deferral patch size would be most easily determined by identifying distinct tree groups meeting established criteria (see below): the size of individual distinct tree groups would dictate patch size. However, deferral patch sizes should be emphasized (but not confined) to occur within the range of natural variability, generally between .05 and 2 acres (Grieg-Smith 1952, White 1985), and using existing group structures on the landscape to guide size.

Patch configuration: Like patch size, determining patch configuration (arrangement/juxtaposition) across treatment areas according to species' needs would be an infinitely complex undertaking. Belsky et.al. (1995) recommend deferring both isolated patches and large aggregations of patches (totaling up to 5 acres) across thinning projects in "eastside" ponderosa and jeffery pine forest ecosystems of the northwest. This would be a useful and applicable guideline for our project.

Total area deferred: Belsky et.al. further recommend retaining at least 20% or more of an area considered for treatment in an unthinned condition. Retention of some dense areas provides important structural diversity, wildlife cover, and undisturbed soil/ understory conditions within managed stands. This would also be a useful and applicable guideline for our project.

Deferral patches and catastrophic fire risk reduction: The proposed deferral patch guidelines maintain a discontinuous canopy structure across the landscape. While localized intra-patch biomass may be greater in deferred patches, the ability of the overall treatment area to carry a continuous crown fire would probably not be significantly increased.

Criteria for identifying deferral patches: It would be desirable if wildlife biologists identified deferral patches on the ground based upon their professional assessments of the presence of attributes generally favorable to canopy dependent, short ranging species:

Intra-patch considerations:

- presence of important structural components including interlocking crowns and branches;
- physiognomic complexity such as broken tops, brooms or oaks;

- distinct (to minimize the amount of thinning required in adjacent/near deferral patch);
- foliage height diversity; a diversity of sizes of trees within patch;
- lack of excessive ladder fuels that would create dangerous conditions during the re-introduction of fire; and
- patch size is determined by the existing spatial distribution of a distinct tree clump, emphasis on .05-2 acre deferral patches is recommended but should not be absolute.

Inter-patch considerations:

- different dominant tree size classes between patches, favoring later seral stages or larger average tree sizes in patch selection;
- retain a variety of patch sizes and shapes; and
- retain both isolated patches and aggregations of patches up to 5 acres in size.

In the remaining matrix outside these dense groups, we recommend discussing how thinning strategies are aimed at achieving overall structural heterogeneity. In fact, mention of this would be useful in discussion of all thinning in the Proposed Action. One approach that would fit nicely is the idea of using changes in soil type to guide thinning intensities across the landscape. A few other phrases that may help further articulate the idea of working with the existing structure in the context of creating more structural heterogeneity are "working back from the best existing structures" and "creating more contrast from the existing forest structure."

Non-Issue: *There is no disagreement with the Proposed Action or anticipated effect with the Proposed Action. The respondent provides potential language and scientific information for supporting and guiding patch distribution south of Kelly Canyon.*

Response: *These items were discussed in a recent meeting with Arizona Game and Fish Researchers and discussed in relation to project design. The ideas are quite good and will be forwarded into the implementation design where management biologist and research biologists will assist in on-the-ground layout of deferral patches. Specific language described here will be beneficial in preparation of prescriptions. Thank you for your time and effort researching these questions.*

McKinnon and Ack

Recent proposals put forth by the Regional Office indicate that future wildland-urban interface projects within 1/2 mile of the national forest boundary will not, based upon proposed changes to LRMP's, be required to follow standards and guidelines for Mexican spotted owl and northern goshawk.

While we don't recall any PAC's or PFA's within .5 miles of the Forest boundary in this project area, we would not support any thinning within them that is inconsistent with existing standards and guidelines.

Non-Issue: *No dispute or disagreement with the Proposed Action.*

Response: *The Kachina Village Forest Health Project is consistent with all standards and guidelines in the current LMP. This future potential amendment has not been applied to this project.*

McKinnon and Ack

Retaining areas of dense forest to facilitate movement of wide ranging species will be a critical component to this project fitting into the surrounding landscape. We are glad to see that movement corridors have been identified already in the project.

Non-Issue*: No disagreement or dispute with the Proposed Action.*

McKinnon and Ack

The Grand Canyon Trust is interested in identifying ways that ensure that some portion of restoration project areas will be managed for old-growth values into the future. We further understand that there are no management area designations specific to old-growth, and that old-growth designations within the Management Area 3—or suitable timber base—means that forests are managed for old-growth values in the context of a 250-year rotation.

In the short term, "existing" and "developing" old-growth designations for the suitable timber base appear to be our best option toward these ends. We recommend that existing old-growth designations are assigned according to the current distribution of all stands that qualify for this designation—includ-

ing but not limited to those in Mexican spotted owl PAC's and northern goshawk PFA's. Using a GIS, we recommend old growth stands be identified as those stands in which existing old-growth conditions were observed during pre-planning transect surveys. We urge the Forest Service to exceed the 20 percent old growth allocation minimum according to "on-the-ground" conditions.

In the longer term, we are very interested in working with the Forest Service to develop a management area status for forest ecosystem restoration. This would include (retroactive, if possible) standards and guidelines for management of restoration treatments to ensure that the restoration process is allowed to unfold and eventually arrive at a healthy, functioning, and mature forest ecosystem. We would be pleased to see this process take place in the context of the Kachina Village Project, however, we understand it will require a Forest Plan amendment and may not be immediately feasible.

Non-Issue: *There is no dispute or disagreement with the Proposed Action.*

Response: *The Kachina Village Forest Health Project will designate old growth according to standards and guidelines in the Forest Plan. All of the treatments proposed will promote development of old growth habitat. The Standards and Guidelines for Northern Goshawk Management direct us to manage for 40 percent VSS 5's and 6's which are old growth or areas with a lot of large trees. The 250-year rotation does not exist per Amendment 11 to the Forest Plan. This item will be further discussed in the EIS.*

McKinnon and Ack

We encourage the Forest Service to assess and prioritize snag and log creation according to Forest Plan standards and/or guidelines across the entire project area rather only in those locations mentioned in the Proposed Action. If there is a need to exempt areas from these values due to fire protection needs, than we encourage defining a distance from the Forest Service/private property boundary in which snags and logs are not prioritized. The .5 mile "intensive zone" suggested in the Region 3 Wildland-Urban Interface Project (2001) may be an appropriate distance.

Non-Issue: *There is no clear debate or disagreement with the Proposed Action based on anticipated effects.*

Response: *The Forest Plan does not provide standards and guidelines for creating log and snag structures. The Forest Plan does provide standards and guidelines for desired densities of snags and logs on the landscape. The creation of snags and logs will be guided by biological and watershed needs. The creation of snags from blackjack ponderosa pine has not been studied and the results of this activity are uncertain. Therefore, the FS is approaching this application conservatively. Monitoring of snags created from large blackjack trees and how many we initially create will be discussed in the EIS.*

McKinnon and Ack

Existing Conditions Description: As alternatives are developed, we strongly encourage the Forest Service to develop a description of existing conditions that clearly and transparently articulates the need for this project. Specifically, we encourage the inclusion of the fire risk assessments that were conducted for the project area, all associated modeling results, and a description of the analyses and data that were employed in arriving at this risk.

Non-Issue: *There is no dispute or disagreement with the Proposed Action.*

Response: *The above mentioned items will be included in an EIS. The FARSITE modeling is also located in the Project Record File and referenced in regard to various comments to this Proposed Action by other publics.*

McKinnon and Ack

Recreation management and roads: We are encouraged by the proposed road network and anticipate further detail on this and recreation management in future documents.

Non-Issue: *No dispute with the Proposed Action*

Response: *Thank for your support.*

McKinnon and Ack

In addition to the opportunities for riparian restoration at Kelly Seep, we believe that Mortgage Springs and Upper Pumphouse Wash (immediately downstream of the private property boundary) merit inclusion. We have included a site assessment of Mortgage Springs in the Appendix. The Grand Canyon Trust is willing to dedicate significant staff time toward writing restoration plans, and implementing restoration projects through our volunteer program. We, therefore, urge the Forest Service to include any additional riparian areas in need of restoration in this project.

Non-Issue: *No dispute with the Proposed Action. Respondent asks for additional items to be included in the Proposed Action.*

Response: *These proposals will be distributed to appropriate staff and could be picked up as separate NEPA projects.*

Germaine

Item 6: AGFD fully supports implementation of a strong research and monitoring effort on both the list of species included in the Plan and on additional species. In our research on the Mt. Trumbull experimental area, we have learned that all taxa for which we have post-treatment information display a strong response to the treatments. Some responses appear positive, as with lizards; some appear negative, as with day-bedding mule deer, whose use of treated areas has declined steadily in the 3 years since treatment; and several have been surprising, as is the case of parasitism rates on nesting western bluebirds. Without hard information on the effects of different treatment prescriptions on various wildlife, we will not have the information we need as Federal and state caretakers of wildlife resources to make informed, responsible management decisions. In addition, using real wildlife response data to make decisions regarding restoration treatments is the only way to reduce the number of lawsuits and appeals that to date have strangled these efforts.

Non-Issue: *No dispute or disagreement with the Proposed Action.*

Response: *We are working with the Arizona Game and Fish Department on research proposals. These proposals are attached and funding is sought to conduct this research and monitoring. We thank the Arizona Game and Fish Department for their work on this important monitoring and research effort.*

Germaine

Item 8 discusses retention of existing large logs. I know you are well aware of the wildlife value of logs and snags, and I urge that extensive precautions be taken to retain these logs, including the possibility of raking away flammable fuels and burning during cooler, moister periods than has existed for several burns at Mt. Trumbull. Most of the old, large logs in treated areas at Mt. Trumbull were lost in the post-treatment burns, often resulting in bare mineral soils in the outline of the lost log. This unfortunate loss can be avoided with greater care taken to protect downed logs.

Item 9: similar to logs, gamble oak motts suffered high levels of fire and logging related mortality in early treatments at Mt. Trumbull. Mortality of oaks declined markedly once fuels crews began removing slash generated from thinning from under oaks and logging crews were given specific instructions to avoid dropping trees into oak motts. Including such language in harvest contracts about reducing logging-related oak mortality would further the retention of live oak trees.

Non-Issue: *No dispute or disagreement with the Proposed Action.*

Response: *The EIS will include mitigation for reducing log and oak loss during prescribed burning. As we have discussed, timing of burning (spring burning) may reduce log loss and will be discussed in the effects analysis of the EIS. My research with Rick Miller (Arizona Game and Fish habitat specialist) has shown oak loss to be approximately 6 percent based on monitoring (Randall-Parker, 2000). The project will include mitigation in burn plans to move large material away from the base of oaks to prevent loss of oak. The EIS will more fully discuss this.*

Germaine

Item 12: Retaining movement corridors and retaining a minimum of 35 trees per 1/10th – 1 acre patches of dense cover as described in this item are both very important components of modern wildlife habitat. We have documented at Mt. Trumbull the need for retaining dense clumps of smaller trees within treated areas for the continued use of these areas by day bedding mule deer. The clumps described in this item will afford appropriate mule deer day bed site structure, based on our models from Mt. Trumbull. **Item 17** discusses retaining 16-inch dbh trees for recruiting into future snag and log habitat components. This is an obvious strength in this Plan, and I encourage retaining more rather than less because some are likely to die in the first post-treatment fires.

Items 10a, 10b, 12, 14, 15, 16, and **17** all address retention of some form of valuable-critical habitat for forest wildlife. Retaining each of the important features discussed in these items will result in decreased availability of marketable trees, potentially higher fire risk at a localized scale, and reduced overall economic potential of the restorative treatments. As such, these items may be opposed by forest industry or fire prevention advocates. However, the habitat features discussed in these items are all vital to the retention of the full array of

wildlife presently found in this area and if compromised beyond the current description in this Plan, will likely result in population declines for at least some of the species mentioned in this Plan

Non-Issue: *No disagreement or dispute with the Proposed Action.*

Response: *This comment agrees with and supports elements of the Proposed Action and supplies supporting documentation from research at Mt. Trumbull for the inclusion of this item in the Proposed Action. Respondent is supportive of the many design features included in the Proposed Action to improve and maintain key wildlife habitats. We thank you for your support.*

Germaine

Separately, too many instances exist where old-growth ponderosa trees at Mt. Trumbull were killed in post-treatment fires that burned cool until reaching the drip line of these trees, then exploded into a trees' canopy because of needle cast under the tree. Many of these trees had had duff raked away from the trunk for 2-3'. To reduce old-growth mortality, I suggest experimenting with raking all needle cast beyond the drip line of old growth trees with a small bobcat outfitted with a rake and balloon tires. A small machine with weight-dispersing tires ought not compact soils much, while saving many of the most valuable trees in this imperiled age class.

Non-Issue: *No disagreement with the Proposed Action.*

Response: *As we discussed, old trees within the project area will have duff raked from the base of the tree where high litter depth layers could result in mortality. The prescribed burn monitoring report and information Rick Miller and Tammy Randall-Parker have prepared will guide our actions. This information and mitigation will be stated in the Draft EIS.*

Germaine

Finally, I laud the efforts of the working group that drafted this plan of action for the Kachina Treatment Block. This plan aggressively attempts to reduce fire risk while acknowledging different levels of fire risk in the urban interface and throughout the forest. Simultaneously, it attempts to increase the overall health of the ponderosa ecosystem, and to maintain an appropriate level of habitat heterogeneity for native wildlife. This Plan is the best-designed attempt to improve the health of the ponderosa forest *ecosystem* that I am aware of. I encourage full support by USFS Coconino National Forest for effects research and monitoring of actions taken under this plan on wildlife populations, both to demonstrate the value of this plan and for comparison to other existing treatment prescriptions.

Non-Issue: *No disagreement with the Proposed Action.*

Response: Thank you for your support and your efforts in the design of research and monitoring proposals for this project.

I approve the Comment Responses and Identification of Preliminary Issues identified for the Kachina Village Forest Health Project.

/s/ Mike Hannemann 12/7/01

Mike Hannemann
Mormon Lake District Ranger

Significant and Non-Significant Issues Final December 2001

Rationale for Non-Significance

1. The issue is outside the scope of the proposed action. (Simply means the issue lies outside the scope of actions and effects of the specific proposal described in the scooping letter; specificity of a Proposed Action is essential to application of this reason for nonsignificance.)
2. The issue is already decided by law, regulation, Forest Plan, or other higher level decisions. (Applies most often to issues already decided by Forest Plans; be careful with issues about whether lands are suited for resource use and production; application of LMP Management Rx's to suitable lands may require project level evaluation.)
3. The issue is irrelevant to the decision to be made. (Some issues have no identifiable relevance to specific decision to be made; the more specific the Decision to be made, the more likely it is this reason will apply.)
4. The issue is conjectural and not supported by scientific (or factual) evidence:. (IDT's ignore this reason because they associate

it only with scientific evidence; but the most common application of this reason is to issues that are unsupported by factual evidence (use records, fire history, actual facts about a proposal including integrated design features); issue may be "unsupported on the basis of factual evidence.)

Process: The preliminary issues identified in the scoping comment summary document have been evaluated in this document to show significance. IDT members met on July 31, August 1, August 2, August 13, and August 21 to conduct this analysis.

Significant Issues

McKinnon and Ack

We appreciate that the Forest Service has articulated that the vast majority of trees to be thinned will be less than 12 inches and that trees greater than 16-inches diameter at breast height will be retained where possible. ***However, we feel that a 16" cap is warranted and should be instituted in accord with the GCFP's recommendation on this project.***

Monitoring of the 16-inch cap at Ft. Valley has revealed that, even in a thinning prescription that gives little deference to tree size, only 2.5 large trees per acre would have been cut in the absence of a diameter cap. And of these trees, only 1 percent were suppressed. The vast majority, or 99 percent of the trees, were dominant or co-dominant trees. Considering the description of thinning from below in the proposed action, "thinning from below results in the removal of smaller, unhealthy trees first and progresses until the target density is reached," it's unclear why any significant reason *not* to include a diameter cap exists.

This is not to ignore the economic realities of restoration. Indeed, smaller trees are more expensive for an operator to handle. There is more handling per unit of wood volume with small trees than larger trees, rendering smaller trees more expensive to thin. If the USFS has an economic argument to make about trees larger than 16 inches, it should make that argument explicitly.

In the absence of such an argument, we believe that there are significant social and political arguments to include a diameter cap. These arguments are of immediate concern to the Grand Canyon Trust and we believe they should be of concern to the Coconino National Forest.

The history of forest management in the Southwest still casts a shadow over our current efforts. It hasn't been very long since most of the big, old trees on the forest were felled at the cost of species viability and overall ecosystem integrity. At the present time, the public perception is that cutting big trees is about revenue generation, and not about the restoration of species and ecosystems.

A 16-inch cap provides the public with a clear, easily communicated guarantee that distinguishes our restoration efforts from those historical practices that have resulted in the need for restoration today. The diameter cap is also about the restoration of public confidence and trust.

With each ensuing discussion of the merits of a diameter cap will come news stories questioning our intent and our legitimacy, using well-honed activist media techniques. These opponents are very effective at whittling away at our legitimacy and weakening public support for restoration. Do we really wish to continue subjecting our efforts to these liabilities?

Having been put in the national spotlight, we also have the responsibility and the opportunity to more clearly define the purpose of restoration by exemplifying the parameters of responsible restoration. Adopting a diameter cap establishes sideboards for restoration that prevent ill-conceived adaptations of our efforts and reinforce a principle we have identified as fundamental to responsible restoration: effective restoration will require substantial reinvestment. Restoration should not be expected to pay for itself.

Considering these points, we are confident that the original recommendation put forth in unanimous resolution by the Grand Canyon Forests Partnership provides a workable and reasonable approach to diameter caps:

> *"Ponderosa pine trees greater than 16-inch dbh will be retained on the land. Black-barked trees in excess of 16 inches may only be treated to achieve the desired objectives of creating grassy openings or enhancing existing forest openings, or to enhance the health of old growth stands or oak clumps. However, all of these trees will be left standing (recruited) as snags or felled and left as downed logs."*

We strongly encourage the Forest Service to include an alternative that evaluates the impacts of the above recommendation in addition

to an alternative that includes and evaluates an 18-inch diameter cap. These evaluations should provide a quantitative explanation of how project objectives will be affected by these different diameter caps, both ecologically and economically. We further suggest that these alternatives explore—perhaps with the help of Rocky Mountain Research Station social scientists—the social, political, and historical dimensions of a diameter cap in the context of ponderosa pine forest restoration in the Southwest.

Nowicki

(The following comments were provided by B. Nowicki in a July 18 and an August 16 letter from the SWFA and others. The two letters included duplicate information, where information was duplicated exactly, it is only shown once, where there were slight variations, the information was retained).

A 16-inch diameter cutting cap is critical. Many sites have been commercially harvested removing a large component of the larger trees from forest structure. Existing large blackjacks will develop into the next generation of old growth. Retaining 16-inch dbh or greater provides some assurance the Proposed Action would not detriment this forest structure further. A 16-inch cap would not impede any of the treatments meeting the stated objectives.

Implement a 16-inch diameter cutting cap throughout the entire Kachina Village Project. Many of the sites within the project area have been commercially harvested, removing a large component of the larger trees from the forest structure. The existing large blackjack ponderosa pine trees will develop into the next generation of old growth in these areas. Retaining all trees with 16-inches dbh or greater would provide some assurance that the proposed action would not detriment even further those degraded forest structures. In fact, even a 12-inch dbh cutting cap would not impede the treatments from achieving the stated objectives, as a large proportion of the trees in the project are smaller than 12-inches dbh. That is, thinning treatments would be able to create a diversity of stand densities and structures by implementing varying levels of thinning the trees less than 12-inches dbh. This analysis and cutting cap is absolutely necessary to protecting vital components of the current forest structure, and the next generation of old growth that will develop in the forest.

Implement "thinning from below, north of Kelly Canyon" within the 1/8 mile (660 feet) immediately adjacent to homes. Beyond the 1/8 mile, implement a variable "thinning from below" to 60-120 BA north of Kelly Canyon. This combination of treatments acknowledges a distinction between wildland-urban interface treatment and general fuels reduction, and delineates a distinct defensible space in the wildland-urban interface. The 660-foot intensive zone provides a defensible space in which a crown fire can be forced to the ground, and in which firefighters can safely work. The less intensive treatment beyond 1/8 mile from houses serves as an extensive zone to reduce fire intensity as it approaches the community. The intensive and extensive zone treatments have been used in the Southwest in the past to protect communities from the threat of wildfire, and should be analyzed for use in this project. Such a method reduces the impact on adjacent forest ecosystems while providing community protection.

Furthermore, Forest Service research shows that the homesites themselves and the areas immediately surrounding houses are the largest factors determining whether houses are at risk of burning from forest fires. Therefore, the EIS needs to analyze the effectiveness and necessity of these treatments in conjunction with the current and future treatments implemented on the private property adjacent to the project. The EIS should also explain why there are areas immediately adjacent to the private property boundaries that are not being treated in this project. The project in its proposed form may implement high levels of forest thinning without effectively and efficiently providing wildfire protection for the adjacent communities.

No new roads should be constructed, even if only for the duration of the project as roads greatly increase soil compaction, transport of exotic weeds and long lasting impacts on forest structure. South of Kelly Canyon all thinning should be done by hand, the limitation would not impede any of the treatments from achieving stated objectives.

No new roads should be constructed for this project, even if only for the duration of the project. Roads greatly increase soil compaction, encourage the transport of exotic seeds, and have long-lasting impacts on the forest structure. The entire project area has previously been heavily impacted by recreation, including heavy traffic of ORV's, and should be spared further damage. Also, no area in the project is far enough from roads to require new

roads to be built. In areas that are prohibitively far from roads, this may limit the size of trees that can be cut. However, this limitation would not impede any of the treatments from achieving the stated objectives.

Do not drive cat lines through the area. For many of the reasons as listed directly above, cat lines should not be used in the area. Fire lines should be created by hand if they are absolutely necessary.

Use only hand thinning south of Kelly Canyon. The use of hand thinning may limit the size of trees that can be cut in some areas away from roads. However, this limitation would not impede any of the treatments from achieving the stated objectives. Using hand thinning, the project will still be able to create a diversity of forest structures and densities throughout the area, including dense patches within a less dense matrix. Most importantly, the use of hand thinning would minimize the soil impacts, protecting the area from further damage, and maximizing its ability to recover and achieve the proposed objectives of forest health and wildlife habitat.

Use only hand thinning south of Kelly Canyon. One of the objectives mentioned early in the planning process was to manage the area south of Kelly Canyon for wildlife, including designating the area as old growth, existing or recruiting. This area is not near houses or communities and is a critical corridor for turkey and bear as well as generally being important wildlife habitat with the potential to develop good old growth characteristics. Designating the area as old growth would provide some protection for this area of the forest as it develops old growth structure and function. Furthermore, the EIS should include a comprehensive analysis of old growth at the forest level as well as the project level, as required by the Forest Plan.

The use of hand thinning may limit the size of trees that can be cut in some areas away from roads. However, this limitation would not impede any of the treatments from achieving the stated objectives. Using hand thinning, the project will still be able to create a diversity of forest structures and densities throughout the area, including dense patches within a less dense matrix. Most importantly, the use of hand thinning would minimize the soil impacts, protecting the area from further damage, and maximizing its ability to recover and achieve the proposed objectives of forest health and wildlife habitat.

Nowicki Comment: The following comments were provided by B. Nowicki on 9/20 on the request of Tammy Randall-Parker. Tammy asked Brian several very specific questions to better understand exactly what some of the comments were addressing. I phoned and asked him to come in and visit, he could not. Instead he sent an additional letter, that did address the questions I had put forward to him regarding roads and my interpretation of their recommendations for the project. (See PRD 110A). The following is his last e-mail.

> Ms Randall-Parker,
>
> I have not been in touch with Taylor, but I hope to speak with him soon regarding the Kachina Village Project. I assume that his lengthy comments are being considered in developing the alternatives.
>
> I will attempt to clarify, as succinctly as possible, the SWFA comments you and I spoke about yesterday regarding the Kachina Village Project. These include: the 1/8-mile treatments around communities, 60-120 BA north of Kelly Canyon, temporary roads, and hand thinning south of Kelly Canyon.
>
> 1/8-mile WUI treatments:
>
> The Forest service researcher Jack Cohen states that the area immediately adjacent to structures (houses) is the most important determinant of whether or not that house will burn. (Many of his ideas are presented in the SWFA document "Protecting Communities from Forest Fires" that can be found on our website www.swfa.org, although I am sure that you can also access his findings directly through the Forest Service.) The ideas regarding protecting houses fit in with the concept of an intensive zone treatment. In many cases, intensive zone treatments (often a narrow band of 1/8 mile= 660 feet= 200 meters directly adjacent to communities) provide a defensible space for fighting fires as well as providing a shaded fuelbreak in which the fire can drop to the ground. The exact prescription for such an intensive zone would be highly site-dependent, and the district fire and fuels experts would have to determine them on a site-by-site basis. However, the treatment generally requires the removal of ladder fuels and a reduction of fuels loads, as well as eliminating continuous canopy so that only relatively small groups and individuals

would be left. "The wildland fuel characteristics beyond the homesite have little if any significance to WUI home fire losses." (Cohen 1999). Therefore, treatment beyond the area immediately adjacent to communities (1/8-mile) should be treated with a general fuel reduction as would be used throughout the wildland forest. Of course, no WUI treatment is effective unless the personal properties and all homesites are treated. However, used in conjunction with home treatment, the above methods can provide real community protection, while at the same time reducing the need for drastic and extensive thinning beyond the area immediately adjacent to communities.

60-120 BA North of Kelly Canyon:

Thinning to a range of 60-120 sq ft BA should provide all of the benefits that are provided by thinning to a 40-120 sq ft BA, but would provide some protection against unnecessary and overzealous thinning. The negative ecological impacts of reducing a significant portion of the forest to 40 sq ft BA could be severe. It is also my understanding that 40 sq ft BA is lower than is necessary to achieve the desired goals of increased forest health and lowered fire risk. (An analysis of the resulting crown bulk density may be most appropriate for determining the latter.) Of course, this range of BA refers only to forested acres, and not openings and meadows. Also, we would assume that the entire range of 60-120 sq ft BA would be represented, and there would not be a bias toward the low end of the range.

Temporary Road Construction:

The negative ecological impacts of road building may far outweigh the benefits gained from an increased level of thinning. Understandably, the lack of new roads may, in some cases, reduce the size of trees that may be removed from an area, thereby affecting the post-treatment stand density. However, in many cases the resulting difference may be marginal. More importantly, the desired effects of thinning may be only slightly reduced, but the negative effects of roads would be entirely eliminated. In some instances, the district may consider cutting trees even though the logs could not be removed by road. In these cases, the logs may be lopped or bucked and eventually consumed by prescribed fire. Of course, in some cases, such methods would create very high fuel loads for the first prescribed fires. In such cases, the district could consider thinning over a series of years, with a series of prescribed fires. Furthermore, the district should analyze the need for roads in each stand, not just the need for them overall.

Hand-thinning South of Kelly Canyon:

Use of hand-thinning in the area south of Kelly Canyon may restrict the cutting cap to 9"dbh. However, thinning with a 9" cap can achieve the goals of the projects. At the same time, the area will be spared the severe impacts of soil compaction and disturbance by large machines. The costs of such soil impacts may far outweigh the ecological costs of leaving a higher tree density on the site.

SWFA expects the Peaks Ranger District to perform a fair and thorough analysis of these issues. Please do not analyze these issues in such a way as to determine, for example, whether a 9" cap will allow you to reach you goal of 40 BA. Obviously, this is circular reasoning and unfair. Rather, analyze whether a 9" cap will allow you to achieve the goals of fire risk reduction and forest health. Present your findings not by simply saying, for example, that one alternative provides greater fire risk reduction than another. Instead, please present your findings as a quantitative result, such as "Alternative X provides only 80% as much increased tree growth as Alternative Y", or "Alternative X will carry a continuous crown fire at 50 mph, whereas Alternative Y will carry one at 60 mph". Presenting the findings as such will allow us to consider the proportional difference in benefits compared to the differences in treatment and collateral damage (such as roads).

Thank you very much for considering these ideas. Please feel free to call me if you have any further questions.

Brian Nowicki

Non-Significant Issues

Bird (April – Response to NOI)

There are concerns from Mt. Trumbull that residual trees in a similar silvicultural-restoration application were lost to mortality. It may be that the residual tree mortality was related to the effects of prescribed burning in combination with unique soil types that resulted in irreversible damage to root systems. The FS must account for such unforeseen possibilities in the Kachina Analysis Area by completing extensive soil surveys, and identifying sensitive soil types where similar mortality might occur. Prescribed burning should be planned spatially and temporally to account for such sensitive soils. Will the ground disturbance associated with silvicultural treatments also impact these sensitive soils?

Conjectural, Unsupported: *We are not aware of any evidence that suggests that "unique, sensitive soils" were a factor in tree loss at Mt. Trumbull. In the Kachina analysis area, the Coconino National Forest "Terrestrial Ecosystem Survey" is used to identify soils that are susceptible to damage from a variety of management practices. Management practices intended to protect soils from damage by prescribed burning will be developed for all treatment areas. Ground disturbance from mechanized equipment has the potential to adversely impact soil condition. Management practices designed to protect soil condition will also be developed for treatment areas.*

Bird (April – Response to NOI)

We are concerned that the Kachina Timber Sale will jeopardize the viability of species that thrive in forest ecosystems through activities associated with timber harvest and ground-disturbing activities intervene in natural disturbance processes that are vital to ecosystem sustainability and degrade water quality and watershed condition. There are populations of focal species and species-at-risk (MIS and TES) that occupy the analysis area and surrounding landscapes that seem to be surviving despite the "unnatural conditions" the Forest Service purports to exist. The FS is required per its 1987 LRMP as well as Federal planning regulations to collect and present information on population numbers and trends for these species as well as define what constitutes the "minimum number" of individuals of each population to secure its long-term viability. The FS must present information to support determinations that the proposed Kachina Timber Sale will not contribute to further declines in these populations and more listing under the ESA. Simply, it is too soon to know how the "treatments" at Fort Valley will affect focal species and species-at-risk.

Conjectural, Unsupported: *Species viability analysis as required in NFMA is appropriately addressed at the Forest Plan level. The 1987 Coconino National Forest Plan and subsequent amendments, including Amendment 11 (1996), include standards and guidelines for wildlife management. These standards and guidelines were developed to meet the needs of Management Indicator Species, threatened, endangered and sensitive species on the Coconino National Forest. The Proposed Action meets all standards and guidelines for TE&S species management as described in the Coconino LMP and Amendments. Consultation with the USDI Fish and Wildlife Service on this project has already occurred (USDI Fish and Wildlife Service 2001). In the biological opinion, the Fish and Wildlife Service concurred with the Forest Service that the Proposed Action is not likely to adversely affect the bald eagle, black-footed ferret or jaguar. A biological assessment and evaluation will be prepared for sensitive species.*

This project is not a timber sale. The goals of the Kachina Village Forest Health Project are to improve forest health and reduce risk from serious and uncontrollable wildfires through a variety of thinning treatments followed by broadcast burning. Serious and uncontrollable wildfires pose a greater threat to species viability than thinning treatments in the Proposed Action. Recreation and access management proposed will also benefit the wildlife which use this area.

Bird (April - Response to NOI)

The Kachina Timber Sale will also damage social and economic uses and values associated with natural forests for the benefit of the timber industry, even though non-timber uses and values are far more important to local communities.

Conjectural, Unsupported: *Forest Service Manual (FSM) and Forest Service Handbook (FSH) 1909.17 contain detailed guidelines for conducting economic and social analysis. However, FSM 1970.3(6) states, "Select cost effective methods of conducting economic and social impact analyses to ensure that the degree of analysis is commensurate with the scope and complexity of the proposed action." FSM 1970.6 adds, "The responsible line officer determines the scope, appropriate level, and complexity of economic and social analysis needed."*

The purpose of an analysis is to assist in decision making. The forest will prepare an economic analysis that displays estimated costs and returns of the alternatives contained within the EIS for the responsible official. The IDT will conduct a financial analysis that will meet this requirement.

"For purposes of complying with the (National Environmental Policy) Act, the weighing of merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations (emphasis added). (FSH 1909.15 41.1(2); FSH 1909.15 22.35; 40 CFR 1502.23. FSM 1905-55 defines "net public benefits" as "an expression used to signify the overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria rather than a single measure or index." This definition is consistent with the direction of complying with NEPA.

The forest will accomplish a balanced decision through consideration of alternatives based on many analyses within the EIS

Germaine

Item 2 discusses retaining ponderosa trees "approximately" 150 years or older. It is not clear how and by whom decisions on these trees will be made. Similarly, this item states that >16" trees will be "retained where possible." What criteria determine retention/removal, and who will make the decision on the fate of an unknown number(?) of trees in such an ecologically important size class from which our future old-growth trees are to be recruited? Finally, I urge that all road and landing locations avoid large diameter trees in all instances, not simply "where possible" as stated in the proposal. In addition to soil compaction, old landings have roads that are often traveled for years even if legally closed, and landings under old trees will unquestionably become popular (renegade) campsites.

Unsupported: *Our marking crews mark all trees and the number of 16" trees anticipated for removal is described in the previous issue response. As we discussed in my office, our experience is that landings can be used as dispersed recreation sites, however this is generally minimal and the project is proposing road closures that will lessen potential for this type of activity.*

Nowicki

The EIS needs to include an analysis of the grazing allotments in this area and appropriateness of grazing in general and the deferment needed to allow ground vegetation to respond after thinning.

Outside the scope of the proposed action: *The area includes portions of two grazing allotments and one sheep driveway. The appropriateness of grazing in this area is outside the scope of the decision to be made. The decision will not decide the appropriateness of grazing for this area. The deferment needed to allow ground vegetation to respond after thinning and prescribed fire is discussed in the Proposed Action. Grazing by wildlife and livestock will be included in cumulative effects in the EIS. As stated in the Proposed Action for this project on page (Item # 16). The annual operating instructions for grazing allotments will be adjusted as needed to allow for recovery of naturally occurring herbaceous communities. Monitoring will be a mitigation item described in the EIS.*

Metzner

Project is way too big for needs pressing. This is another move by the government to control the people's freedom of movement and grab public lands. Scope of project is way out of line for a natural forest. More controls on camping and where, not needed or wanted. We do not want more controls on people's freedoms. Leave the trails alone for the people who use them.

Conjectural: *We are changing the types of access to certain areas and changing the type of use in some areas but not eliminating uses within the project area. People are free to move about this area and, therefore, we are not controlling the people's freedom of movement to the project area. The changes in camping are needed to reduce fire risk. In the last 30 years, there have been 205 fires in the Kachina Village Project area, with 151 of those human caused. These fires have originated from four central areas, including FR's 237 and 535 and the Mexican Pocket Area. These areas are proposed for designated dispersed camping and will result in camping and campfires isolated to small areas which will be treated to lessen the risk of a large wildfire that would originate from the camping locations. The grab at public lands statement is conjectural as these are public lands. Lastly, trails are causing resource damage to the area. Forest Service designated trails are proposed to replace the "user created" trail system. The "user created" trail system has dam-*

aged meadows, riparian habitats, and wildlife habitat. The FS system will be built following wildlife, archeological, and watershed assessments and be constructed using best management practices to protect the forest.

Bird

The proposal represents a "sledgehammer" approach to forest management, the extensive logging proposed has the potential to exacerbate fire danger, extirpate wildlife, and increase sedimentation and flooding.

Unsupported: *The Kachina Village Forest Health Project was designed by wildlife professionals from the USDA Forest Service, Arizona Game and Fish Department, and USFWS, along with Northern Arizona University professors and Rocky Mountain Research Station scientists. Wildfire professionals from the USDA Forest Service and Northern Arizona University along with Rocky Mountain Research scientists and personnel from the Flagstaff Fire Department, Highlands Fire Department and Arizona State Land Department assisted in the design of the project with fire reduction goals in mind. Professional foresters from the USDA Forest Service and Northern Arizona University along with Rocky Mountain Research Station scientists were involved in the design of thinning methods and prescriptions to meet project objectives. Hydrologists from the USDA Forest Service have consulted with ADEQ and contributed to the design of the project, where the greatest threat is a wildfire to the Oak Creek watershed. Many months of review, discussion and planning by over 30 professional resource specialists hardly represents a "sledgehammer" approach as you have described.*

There is a substantial body of knowledge that supports the value of thinning and prescribed burning to produce quality fuels treatments and forest health objectives. There also is a strong body of evidence supporting the notion that crown fire potential is reduced by reducing canopy density and raising crown base height. The consensus in the fire science community is that lower stand densities and reduced fuel volumes are necessary for maintenance of "fire safe" forests. As Agee points out (1996, pgs. 52-68 in: Proceedings 17th Forest Vegetation Management Conference, Redding, CA), "..fire safe forests are not fire proof, but will have":

- Surface fuel conditions that limit surface fireline intensity;
- Forest stands that are comprised of fire-tolerant trees, described in terms of species, sizes and structures; and
- A low probability that crown fires will either initiate or spread through the forest."

The single most ecologically damaging and life threatening forest fire is the crown fire. The intensity of crown fires prevents direct fire suppression. The massive blizzard of embers associated with crown fires leads to long-range spot fires which circumvent areas with little fuel. The presence of numerous spot fires leads to erratic fire behavior and rapid acceleration in a fire's growth. The most critical element to fire management is the prevention of crown fires. This is a primary goal of the Kachina Village Forest Health Project.

In planning the Kachina Village Forest Health Project all of the objectives, standards and guidelines in the Coconino Land Management Plan and amendments were used, hereafter referenced as the Forest Plan. This environmental assessment is tiered to the Environmental Impact Statement for the Coconino Forest Plan. The Kachina Village Forest Health Project meets all standards and guidelines for management as described in the Forest Plan. Specifically, Amendment 11 to the Coconino Forest Plan was reviewed thoroughly. This amendment to the plan includes the recommendations for the northern goshawk, Mexican spotted owl and old growth management. The standards and guidelines are the result of the recommendations made by scientific management teams, which prepared the Recovery Plan for the Mexican Spotted Owl, *(Block, et. al. 1996) and* Management Recommendations for the Northern Goshawk in the Southwestern United States, *(Reynolds, et.al.1992). Both of these documents were frequently referenced and reviewed when designing and preparing the Kachina Village Forest Health Project.*

The Recovery Plan for the Mexican spotted owl states that "two primary threats that should be the focus of such management priorities are catastrophic wildfire and widespread use of even-aged silviculture, Block et.al. 1996."

The *"Recovery Plan"* reads as follows:

> *"Heavy accumulations of ground and ladder fuels have rendered many Southwestern forests vulnerable to stand-replacing fires. Such fires represent a real and immediate*

threat to the existence of spotted owl habitat. The management guidelines are intended to provide land managers with flexibility to reduce these fuel levels and abate fire risks. Fire management should be given the highest priority. (Recovery Plan for the Mexican spotted owl, 1996 (page xii))

The "Management Recommendations for the Northern Goshawk in the Southwestern United States" state the following:

Southwestern forests have been altered from presettlement conditions by fire suppression, timber harvesting, livestock grazing, mining, and recreational uses. Prior to fire suppression in the Western United States, ponderosa pine forests were burned by low-intensity surface fires at 2- to 15-year intervals. Fires burned at lesser frequencies in mixed-species forests (5-22 years). These fires maintained forests that were relatively open and dominated by mature trees by regularly burning and killing small trees.

Habitat changes resulting from fire suppression in ponderosa pine and mixed-species, and to a lesser extent spruce-fir forest, are: 1) the replacement of open, single-storied stands by dense multistoried stands, through tree regeneration; 2) loss of natural openings by tree invasion; and 3) changes in the abundance an composition of plant species in both the understory and overstory due to plant succession.

Accumulated fuels and dense forest conditions resulting from fire suppression have also increased the potential loss of goshawk habitat through catastrophic wildfire and epidemic infestations of insects and diseases. Increased shading from the denser regeneration has also reduced herbaceous and shrubby understories that provide important food and cover for goshawk prey. Livestock and wildlife browsing have accentuated this loss. In addition to these changes, timber harvesting which began in the 1800's, has focused on large trees, resulting in few remaining mature and old forests and associated habitat attributes.

The present conditions in southwestern ponderosa pine and mixed-species forests reflect the extent of human interference with natural processes. Given the improbability of returning to the previous frequencies of natural disturbances, some active management (mainly thinning and prescribed fire) will be necessary to produce and maintain the desired conditions for sustaining goshawks and their prey. (Executive Summary pages 5 - 6)

The team that worked on developing the Proposed Action considered all of this information in light of the fires we have experienced in this area since 1994 and the effects on Mexican spotted owl, northern goshawk and other wildlife species affected by recent fires.

Bird

The proposal forces the taxpayer to foot the bill for an enormously expensive project whose benefits are highly uncertain.

Conjectural, Unsupported: *The respondent has a dispute with the Proposed Action, however, the anticipated effects—which are economi— are not supported or substantiated by any facts or supporting information. The EIS will include an economic analysis and effects analysis.*

Bird

Temporary road construction will simply increase the environmental costs of the Kachina Project, increase fire hazard as they are used by ORV's and provide additional public access. The only reason the roads are needed is to remove commercial materials.

Unsupported, Conjectural: *Temporary roads are used for a very short period of time during thinning and then obliterated. There is no data or research to show that short-term effects of increased fire hazard exist or that ORV use increases. The respondent has provided no affects associated with ORV use of roads for short periods of time.*

Bird and Nowicki Clarification Letter

It remains entirely unclear what purpose the 3-foot-wide dozer line along the canyon rims will serve. This construction might potentially change the hydrology of the canyon system significantly by redirecting runoff away from the canyon edges.

Do not drive cat lines through the area. For many of the reasons as listed directly above, cat lines should not be used in the area. Fire lines should be created by hand if they are necessary.

Unsupported, Conjectural: *As part of the prescribed burning portion of the Kachina Village Project, fire control lines will be necessary to keep fire in predetermined locations and also to keep fire out of sensitive areas and steep inaccessible terrain such as Kelly and James Canyons. When possible, natural and other features such as rockslides, elk trails, roads or old skid trails are used instead of constructing new control lines. When the construction of control lines is necessary, control lines are generally constructed to the most minimal extent possible. On prescribed burns in similar terrain to that of the Kachina Village analysis area, minimal line construction by hand or by using wet line are the preferred methods. When burning is complete, crews install waterbars and recondition lines. In some cases, mechanized equipment may be used. The Peaks and Mormon Lake districts have had good success with using a small bulldozer and having the operator only use the corner of his blade. This constructs a control line of 1 to 3-feet wide. When the project is complete, the operator can roll back the material pushed aside and contour to the original condition. Control lines constructed near Kelly or James Canyon will not be located directly near the rim of the canyon for two reasons. First, control lines are preferred on flatter terrain with less likelihood of rolling material having a chance to roll into the canyon. Second, as part of the analysis process, it was agreed to leave denser cover on the rims of the canyons for wildlife cover.*

There is no anticipated influence on runoff characteristics associated with this action.

McKinnon and Ack

South of James Canyon, in areas proposed for thinning and burning, cheatgrass (*Bromus tectorum)* is a regular and often dominant understory species. We are concerned that the proposed treatments by themselves—especially burning—may facilitate its further spread and competition with native species. We strongly encourage the Forest Service to assess the need for an integrated strategy to improve, rather that potentially exacerbate the problem, both south of James Canyon and in other locals within the project area where cheatgrass poses a foreseeable risk.

The Nature Conservancy's Wildland Weeds Management and Research Program has developed the following recommendations for the management of cheatgrass. We've attached this document in its entirety as an appendix to these comments for your use.

Lasting control of cheatgrass will require a combination of chemical control, physical control, vegetative suppression, and proper livestock management where land is grazed. This "cumulative stress" method will keep the plants constantly under stress, reducing their ability to flourish and spread. Also, a cumulative stress approach provides a level of redundancy in case one type of treatment is not implemented or proves to be ineffective.

An effective management program needs first to control existing infestations, and second to develop a land management plan to deter re-infestation of Bromus tectorum. New infestations should be controlled first before cheatgrass becomes dominant and alters the soil chemistry of the area (Belnap pers. comm.). Since cheatgrass reproduces entirely by seed, the key to controlling existing infestations is to eliminate new seed production and deplete the existing seed bank.

Bromus tectorum is most commonly controlled with herbicides. Quizalofop, fluazifop, sethoxydim, paraquat, glyphosate, and imazameth can be applied in the early spring, before perennial grasses have emerged, to control cheatgrass. Additionally, sulfometuron methyl, and atrazine can be applied in the fall to control cheatgrass in winter crops. Several of these herbicides may damage established perennials. Therefore, the timing of herbicide application is crucial to ensure that cheatgrass is selectively controlled. Burning is usually conducted in late May or early June, after the plants have dried (Beck, pers. comm.). Reseeding native perennial grasses is necessary after burning or cheatgrass and other weeds will simply reestablish in the disturbed area.

A two to three-year combination of burning, herbicide application, and reseeding can be used to control and re-vegetate an area that is almost exclusively dominated by cheatgrass. Burn and re-seed the area with native perennial grasses during the first year. The following spring, apply herbicides before the seeded perennial grasses emerge in order to eliminate any cheatgrass that emerged from the seedbank after the burn. If necessary, apply a second round of herbicides early in the spring of the third year to control any new

cheatgrass seedlings and provide time for native bunchgrasses to establish. This should control the cheatgrass, deplete the existing cheatgrass seed bank, and provide adequate time for perennial grasses to establish to the point where they can suppress any new cheatgrass invasions.

If the area is only partially infested with cheatgrass, burning is usually not recommended (Belnap, pers. comm.). Cheatgrass can rebound quickly after a fire and the elimination of the remaining valuable species will only enhance its ability to spread.

Hand pulling cheatgrass is very labor intensive and is worthwhile only on very small infestations. Mowing and cutting are not usually recommended methods of control. Plants that are cut before seed ripening will regenerate new culms and produce seeds at the cut height. Plants that are cut after seed ripening will die, but by this point the seeds are already viable. However, repeated mowing (every three weeks) can eliminate cheatgrass seed production in areas were herbicide applications are unacceptable or cannot be safely used.

Once an area has been treated, native perennial grasses should be plugged and/or re-seeded or cheatgrass will return to pre-burn densities within a few years (Beck, pers. comm.). Hilaria (Hilaria jamesii) has been observed to grow well in cheatgrass infested areas of the Colorado Plateau by taking advantage of warm summer rains (Belnap pers. comm.).

Unsupported: *The comment that the Proposed Action will exacerbate the cheatgrass problem is unsupported. The EIS will include effects analysis, as well as common mitigation items which will lessen spread of this species. Cheatgrass is associated with disturbed areas and after treatment, cheatgrass would be expected to increase. Cheatgrass is currently widespread within the project area, however density is low. Cheatgrass in the Southwest will do very well when we have a wet spring. A wet spring following treatments has the potential to increase cheatgrass throughout the project area. Cheatgrass can be easily out competed by native grasses which flourish during the wet monsoon season in the Flagstaff area. In short, cheatgrass in this part of the country is very cyclic with boom and bust years, dependent upon weather conditions. The project will include seeding high disturbance areas with native grasses to lessen cheatgrass expansion. The project will also include fall burning in some location which will lessen cheatgrass spread. The project, by virtue of opening up areas, will benefit native understory species which will reduce and lessen the spread of cheatgrass. Mitigation will be listed in the draft EIS to reduce cheatgrass expansion in this area.*

McKinnon and Ack

The interruption of natural processes in Southwestern ponderosa pine forests has been attributed to widespread intensive livestock grazing that was introduced in the mid and late 19th century. Upon introduction, livestock grazing removed the herbaceous understory that is believed to have limited pine seedling establishment and, therefore, also tree densities through competition for light, water, and nutrients, in addition to carrying frequent low intensity ground fires.

In the absence of this "competition fire filter" that limited pine seedling establishment, anomalously high densities of trees have established that now facilitate similarly anomalous high-intensity crown fires that threaten ecological and human values alike. In addition, the pine irruptions have led to a decline in overall biological diversity of these forest ecosystems, much of which was historically based on the understory.

Considering this, perhaps the most critical element to the restoration process for ponderosa pine forests is ensuring that we facilitate understory (grass and forb) recovery. In part this must come through control of herbivores. Of the two major herbivore pressures currently on the landscape (elk and domestic livestock), we can only directly control the intensity, seasonality, and duration of domestic livestock grazing.

We think the appropriate frame of reference for considering post-treatment (thinning and/or burning) livestock grazing begins with the assumption that the most desirable management regime—and the one that will most likely facilitate our restoration goal of understory recovery—is livestock grazing deferral for a period of time.

Based upon our observations at other restoration sites, and discussions with Forest Service personnel, we recommend this period of time span at least three growing seasons. We further recommend that quantitative and qualitative measures of recovery should inform whether, after three growing seasons, livestock should be reintroduced, and if so, at what

intensity, seasonality, and duration. One measure of recovery included in this assessment should be whether the native understory is capable of carrying low-intensity grass fires.

Conjectural, Unsupported: *The recommendation of a three growing season deferral is unsupported, rather monitoring should be used to determine the proper timeframe. The area includes portions of two grazing allotments and one sheep driveway. The deferment needed to allow ground vegetation to respond after thinning and prescribed fire is discussed in the Proposed Action. Grazing by wildlife and livestock will be included in cumulative effects in the EIS. As stated in the Proposed Action for this project on page 6 (Item 16). The annual operating instructions for grazing allotments will be adjusted as needed to allow for recovery of naturally occurring herbaceous communities. Monitoring will be a mitigation item described in the EIS.*

I approve the Significant and Non-Significant Issues for the Kachina Village Forest Health Project.

/s/ Mike Hannemann 12/07/01

Mike Hannemann
Acting Mormon Lake District Ranger

Alternative Document Including Alternatives Suggested by the Public Final December 6, 2001

This document tracks the formulation of alternatives based on significant issues and alternatives suggested by the public.

Alternatives Considered but Eliminated from Detailed Study

Bird (April NOI response – April 19, 2001) – Alternative Suggested

The Forest Service and GCFP have not offered information that would preclude a purely process-based restoration alternative. We ask again that the Forest Service fairly and accurately analyze an alternative that would apply prescribed burns only with necessary pre-fire fuels treatments, such as raking needless from trees 24-inch dbh, pruning lower ladder-branches, etc. Such non-commercial approaches to restoration are being implemented across Arizona by the Forest Service including the Peaks Ranger District.

Response: *Prescribed fire without thinning over the entire project area, as a distinct alternative, was not practical from a biological standpoint, nor did it meet the Kachina Village Forest Health Project objectives. Therefore, it was not considered as an alternative that would use your suggestion across the entire landscape. However, this treatment is incorporated into the Proposed Action to achieve a mosaic of effects. Prescribed fire without any mechanical thinning is proposed for those stands in which it will be effective and the desired effects are likely to be achieved.*

*The **prescribed fire without thinning alternative** was not developed as a distinct alternative for the entire project area, because it did not meet enough of the project objectives. There are two main reasons: 1) prescribed fire alone is not effective in thinning the sizes of tree in the project area, and 2) prescribed fire alone does not substantially reduce the risk of future catastrophic wildfire because not enough trees are killed. The following information discusses these two points.*

1) Most studies indicate that prescribed fire alone is not effective in thinning the sizes of trees in the Kachina Village Forest Health Project.

Prescribed fire is not a very selective thinning tool, because a number of fires are required to reduce fuels, change the understory, and overcome the effects caused by fire exclusion (Harrington and Sackett 1990). Gaines and others (1958), Woolridge and Weaver (1965), and Lindemuth (1960) all reported that fire was a rather imperfect tool for thinning. Harrington (1987) reported significant reductions in tree density within sites occupied by "dog-hair" thickets, while the same prescribed fire did little to reduce tree density where sites were dominated by larger trees. Sackett (1980), Davis and others (1968), and Campbell and others (1977) reported similar results in both prescribed and natural fires (Weatherspoon 1996).

In another study, Gaines et al. (1958) reported that even though younger, suppressed classes had been thinned by fire, the commercial overstory suffered substantial injury. The trees Gaines refers to as "the commercial overstory" in 1958 are the larger, older trees this project wishes to keep alive for wildlife diversity. Lindenmuth (1960) studied the effects of fire in east-central Arizona and concluded that 24 percent of the potential crop trees were released from competition, but 17 percent were killed or severely damaged. Again, the trees Lindenmuth refers to in 1962 as "crop trees" are the larger, older trees this

project wishes to keep alive for wildlife diversity. Harrington (1981) reported an average of 26 percent reduction in stems per acre in southeastern Arizona, however surveys in years following the burns revealed results that need special attention—which is the subsequent loss of old-growth ponderosa pine trees.

Attempts to use fire alone to thin dense stands frequently resulted in high levels of mortality in the residual stands (Swezy and Agee 1991, Sackett and others 1996, Covington and Sackett 1984). Post-fire mortality among old growth trees was 23 percent higher in burned plots than in the unburned controls over a 20-year period (Sackett and others 1996). More than 30 years of study (since 1976) at the Fort Valley Experimental Forest has demonstrated that fire alone cannot effectively reduce stand levels enough to protect remaining mature and old growth trees. Allowing prescribed fires or wildfires to selectively thin pine forests of the Southwest may be the most detrimental in retaining what old growth trees that remain (Weatherspoon 1996).

Substantial research has demonstrated the effectiveness of thinning as one component in a forest restoration program (Swezy and Agee 1991, Fiedler 1996, Fenny and others 1996, Weatherspoon 1996, Edminster and Olsen 1996, Covington and others 1997, Scott 1998, Harrington and Sackett 1990). Therefore, some combination of thinning, manual fuel removal, and prescribed burning will be necessary to restore ponderosa pine ecosystems to more natural conditions (Arno 1996; Fiedler 1996; Swezy and Agee 1991; Oliver and others 1994).

Most research points out the imperfection of fire as a thinning tool. Prescribed fire by itself is not effective in thinning ponderosa pine trees with diameters over 3 inches or trees that are over 6 feet tall without significant damage to the larger, older trees this project wishes to retain. On the Kachina Village Forest Health Project, the trees in overabundance and in need of thinning are predominantly 5-16 inches in diameter (PRD 79 and PRD 79A).

Beginning in the 1930's, research was conducted to evaluate the effectiveness of a range of treatment strategies to reduce stand densities and fuel loads. Many researchers initially believed that simply reintroducing fire would be sufficient to substantially reduce both stand densities and fuel loads. Prescribed fire has been a successful means of fuel reduction in some forest types (Biswell and others 1973, Knorr 1963, Weaver 1952).

Folliott et al. (1977) reported that a positive thinning response followed prescribed fire in northern Arizona, but basal area was not reduced enough for optimal stand stimulation. Weaver (1947) reported that 30 years after burning, a young ponderosa pine stand had fewer stems per acre, greater heights, and larger diameter than an adjacent unburned stand.

2) Using prescribed fire without thinning does not substantially reduce the risk of a catastrophic wildfire.

One of the project's primary goals is the reduction of catastrophic (crown) fire. The risk reduction is accomplished by reducing the amount of ladder fuels and tree canopy fuels, as well as by reducing the amount of ground fuels (Ottmar 1997; Agee and others 1999; Buckley 1992; Van Wagtendonk 1996). Reducing ground fuels temporarily reduces the fuel load and ground fire intensity that could initiate a crown fire. Removing ladder fuels will reduce the potential for ground fire to climb into the tree crowns. However, only by recreating a discontinuous canopy layer can a treatment inhibit the rate of spread and the eventual extent of a destructive crown fire.

In a report of the National Commission on Wildfire Disasters, Sampson (1994) states many forest situations will require mechanical removal of excess trees via thinning before fire can safely be re-introduced. In an extensive 1995 report to Congress, the Sierra Nevada Ecosystem Project (ponderosa pine is a major forest type in the Sierra Nevada) authors concluded that an extensive modification of forest structure by thinning and burning is needed to minimize severe fires in the future (McKelvey and others 1995). In an extensive scientific evaluation (involving over 100 scientists) of the effects of Forest Service management practices on the sustainability of eastern Oregon and Washington ecosystems (ponderosa pine is a major forest type), Everett and others (1994) found a need to use thinning as one of several actions to restore wildfire to more natural behavior. In contrast to the destructive crown fire, a more natural fire behavior for ponderosa pine forests is a low intensity ground fire with flame lengths less than 2 feet.

Bird (July 23, 2001) – Alternative Suggested

Develop a non-commercial alternative, restoration alternative that uses non-commercial treatments in the WUI*. Focus efforts on private homeowner education and assistance, encouraging re-introduction of fire outside the WUI. Homeowner education

would be a coordinated program of public presentations, direct mail education, media public interest education and news features. The local economy stimulated through local landscape businesses and construction companies retrofitting home sites for protection. Jobs and income generated by activities on Federal lands that prepare the forests outside the WUI for re-introduction of fire.

Goals include:

1) improve protection of homes
2) economic opps
3) clean water and healthy watersheds
4) restore wildfire to forest ecology
5) improve scientific understanding of fire ecology
6) improve public understanding of fire ecology and forest management.

Alt. Based on work of Jack Cohen: 40 meters of home most important; beyond 40 meters has little effect on the likelihood a home will burn.

*Inside WUI—focus on most flammable material—brush and weeds and lower branches of trees. Prioritize treatments around communities.

Outside the WUI use prescribed fire—prioritize use—inconjuction with non-commercial preparation such as brush removal, needle raking and lower branch pruning. If small tree removal is scientifically justified, offer as public fuelwood by permit only.

Response: *The respondent has overlooked that this project has a purpose and need which goes beyond the purpose and need for reducing fire potential. The purpose and need is aimed at long-term improvement of forest health. The description of work proposed by the respondent within the WUI and outside the WUI are very similar. As described in the previous response, these actions would not meet the objectives of the Kachina Village Forest Health Project. Prescribed fire with only raking, pruning, etc. will not meet most all of the purpose and need for this project.*

The Federal Government does not have the authority to require homeowners to change physical conditions present on private land. However, the city and county have some authority through ordinances and such. In the Flagstaff community the Forest Service and local fire departments have provided education as well as assistance to private landowners to reduce wildfire risk. The Proposed Action includes ongoing efforts that include working with homeowner's adjacent to the communities of Flagstaff, Kachina Village, Mountainaire and Forest Highlands. Local fire departments, as well as the Forest Service, have conducted public presentations and completed direct mail education. Almost daily there are articles in the paper and news media across the West regarding homeowner preparedness. However, this in and of itself will not solve the problems south of Kachina Village and Forest Highlands.

There are numerous small businesses in the Flagstaff area that conduct thinning and prescribed burning on private land and replace shake-shingle roofs with metal ones. Many of the goals of your alternative are similar to our goals and goals of the Grand Canyon Forests Partnership. However, your goals will never be met with the alternative you have recommended, especially Item 1 (protection of homes).

All lands adjacent to Forest Highlands and Kachina Village that are in need of treatment to address declining forest health and reduce high fire hazard are proposed for treatment. A fire in this area (as shown with Farsite Modeling PRD #73) will easily travel 2.5 to 3 miles in one afternoon, thereby prompting us to look at the entire area in order to protect MSO PAC's, old-growth habitats, old trees, northern goshawk habitat, cultural sites, the Oak Creek watershed and homes in Forest Highlands and Kachina Village. Direction in the Coconino LMP provides guidance on the size and scale of the urban interface. Page 93 of the Coconino LMP defines the urban interface as an area up to 10 miles long in a southwesterly direction from urban areas.

Reducing stand densities throughout the Kachina Village Project area is critical to reducing fire potential. The single most ecologically damaging and life threatening forest fire is the crown fire. The intensity of crown fires prevents direct fire suppression. The massive blizzard of embers associated with crown fires leads to long-range spot fires which travel over and beyond areas with little fuel. The presence of numerous spot fires leads to erratic fire behavior and rapid acceleration in a fire's growth. The most critical element in fire management is the prevention of crown fires. It is important to evaluate fire potential miles away from communities as well as immediately adjacent to them.

Nowicki

In fact, even a 12-inch dbh cutting cap would not impede the treatments from achieving the stated objectives, as a large proportion of the trees in the project are smaller than 12-inches dbh. That is, thinning treatments would be able to create a diversity of stand densities and structures by implementing varying levels of thinning the trees

less than 12-inches dbh. This analysis and cutting cap is absolutely necessary to protecting vital components of the current forest structure and the next generation of old growth that will develop in the forest.

Response: *A 12-inch cap was analyzed by reviewing forest vegetation simulator computer modeling and applying professional knowledge to decide if a 12-inch cap would result in a viable alternative for the Kachina Village Forest Health Project.*

FVS (Forest Vegetation Simulator) computer runs modeled under different scenarios show diameter, density, and mortality conditions after different thinning scenarios. These scenarios were picked to either show likely cuts that would be made in action scenarios, or to help analyze certain alternatives (such as what happens if we impose a 12-inch cap on cutting trees). Original data was taken from compartment exam points collected in 1989 that had approximately 20 percent sample error and a confidence level of about 67 percent. Seven stands were selected to model that show a range of both densities and site indexes that reflect the Kachina project area in general. In all the scenarios, only ponderosa pine was simulated for cut, even though many of the stands have an oak component.

A 12" cap scenario attempted to cut stands to a 50 BA, which is needed to meet goals and objectives in the Proposed Action such as reducing wildfire potential, increasing understory and increasing individual tree growth. In most cases, 50 BA could not be achieved, so the model cut almost everything (a cutting efficiency of 0.95) between 5 and 12-inch dbh. Four out of the seven stands that were modeled still had considerable BA over 50 BA. This scenario also tends to have slightly lower growth rates for the remaining trees than other alternatives modeled. Growth was evaluated over a 50-year period. In addition, the model indicated a higher mortality rate in stands treated with a 12-inch cap over the same 50-year period. The target densities recommended in the Proposed Action could not be met with the 12-inch cap. Objectives to enhance understory, create grassy openings and reduce wildfire potential could not be met in the majority of the project area if a 12-inch diameter cap is imposed. To enhance the understory, it is desirable to reduce BA to less than 40. Diameter caps, in general, reduce our ability to create grassy openings due to the distribution of trees on the landscape. A 12-inch diameter cap would make it impossible to meet our objective for creating 10 percent grassy openings within treated stands. Higher BA's that would result from a 12-inch cutting cap, would not decrease stand densities that would achieve our goal of reducing fire potential. Fire potential would remain moderate to high across most of the project area.

Alternatives To Be Studied in Detail in the EIS

Alternative A – Proposed Action (PRD 92)

Alternative B – No Action

Alternative C – Proposed Action with 16" Cap Based on the Following Issues

Alternative D - Proposed Action with 18" Cap Based on the Following Issues

Alternative E – Proposed Action with Modifications Based on Issues of Roads and Concerns for Wildlife Habitat Posed by SWFA.

Issue Driving Alternatives C

(McKinnon and Ack – July 18, 2001 and Nowicki – July 18, 2001) - Alternative Suggested with Issues explained

Summary of Comment which developed Alternative: The first point is a social/political issue based on public trust. At the present time, the public perception is that cutting big trees is about revenue generation and not about the restoration of species and ecosystems. A 16-inch cap provides the public with a clear, easily communicated guarantee that distinguishes today's efforts from historical practices. The second point is that the existing large, blackjack ponderosa pine trees will develop into the next generation of old growth in these areas. Retaining all trees with 16-inch dbh or greater would provide some assurance that the Proposed Action would not detriment even further those degraded forest structures.

Description of Alternative C: This alternative places a 16-inch diameter cap on the proposed action. The Proposed Action would drop the element of creating logs and snags due to the lower value of smaller logs and snags that would be created by trees less than 16 inches. There are no other changes to the Proposed Action.

Evaluation Criteria: Based on the comments received, the changes in vegetative structural stage, old growth development, creation of logs and snags, social and economic effects are discussed in the draft EIS. The implementation of a 16-inch diam-

eter cap would result in approximately 7,000 fewer trees thinned from the landscape. This results in a change in VSS structure of less than 1 percent. The creation of grassy openings, based on professional experience, will be difficult to achieve in many of the treated stands.

Issue Driving Alternative D

(McKinnon and Ack – July 18, 2001)– Alternative Suggested with Issues explained

Summary: An evaluation of an 18-inch cap should provide a quantitative explanation of how project objectives will be affected by different diameter caps.

Description of Alternative D: This alternative places an 18-inch diameter cap on the Proposed Action. The Proposed Action maintains the element of creating logs and snags from the trees 16 to 17.9-inch dbh. There are no other changes to the Proposed Action.

Evaluation Criteria: Based on the comments received, the changes in vegetative structural stage, old growth development, creation of logs and snags and social, and economic effects are discussed in the draft EIS. The implementation of a 18-inch diameter cap would result in approximately 2,000 fewer trees thinned from the landscape. There is no change in VSS from the Proposed Action. Creation of grassy openings, based on professional experience, will be difficult to achieve in some stands.

Issues Driving Alternative E

Nowicki – August 16 and September 20, 2001– Alternative Suggested with Issues explained

Summary: An intensive treatment zone should occur in the area around private land. Thinning north of Kelly Canyon should be lighter than that proposed, with a 16-inch cutting cap imposed. No new roads should be constructed, even if only for the duration of the project as roads greatly increase soil compaction, transport of exotic weeds and long lasting impacts on forest structure. The use of hand thinning (south of Kelly Canyon) would minimize soil impacts, protecting the area from further damage, and maximizing its ability to recover and achieve the proposed objectives of forest health and wildlife habitat. Restricting the cutting cap to 9-inch dbh will spare the impacts of soil compaction and disturbance by large machines in the areas south of Kelly Canyon.

Description of Alternative E: Implement "thinning from below, north of Kelly Canyon" within 1/8 mile (660 feet) immediately adjacent to homes "intensive zone." Beyond 1/8 mile, implement a variable "thinning from below" to 60-120 BA north of Kelly Canyon. No new roads should be constructed, even if only for the duration of the project as roads greatly increase soil compaction, transport exotic weeds and long lasting impacts on forest structure. Temporary roads are needed to access areas within the "intensive zone." A phone call to B. Nowicki on 10/31/01 resulted in changing no new temporary roads to constructing temporary roads to accomplish thinning objectives within the "intensive zone." South of Kelly Canyon all thinning should be done by hand with no trees over 9-inch dbh removed.

Evaluation Criteria: Based on the comments received, the changes in vegetative structural stage, old growth development, creation of logs and snags, temporary road construction and change in the potential for wildfire are discussed in the draft EIS. This alternative will result in the use of 2.5 miles of temporary road compared to 5.75 miles with the Proposed Action, Alternatives C and D. The temporary road issue also resulted in more areas of 9" thinning north of Kelly Canyon (556 acres). In total, this alternative will place a 9" cap on 2,668 acres compared to the Proposed Action which has a 9-inch cap on 527 acres. The 9-inch cap and 16-inch cap will make it very difficult to create any grassy openings. The "intensive zone" will create a continuous grassy strip along the private land boundaries.

I approve this range of alternatives to be considered in the Kachina Village Forest Health Project.

/s/Mike Hannemann 12/07/01

Mike Hannemann
Acting Mormon Lake District Ranger

Appendix B • Research Proposals

Evaluating Ponderosa Pine Forest Restoration Effects On Mule Deer—A Research and Monitoring Proposal - Emphasizing the Kachina Village Forest Health Restoration Project - Mormon Lake Ranger District, Coconino National Forest

Arizona Game and Fish Department
Research Branch
2221 W. Greenway Road
Phoenix, AZ 85023

September 1, 2001

Introduction

We are seeking funding to answer key ecological questions about restoring fire-adapted western forests to healthier, more natural conditions. Exclusion of natural surface fires, logging, and historical overgrazing have led ponderosa pine forests across the West to become over-dense with small trees and accumulated fuels, leading to costly tragedies such as the May 2000, Cerro Grande Fire that burned across Los Alamos, N.M. Other effects include reduced tree vigor, reduced herbaceous diversity and biomass, and type conversions from fire-adapted species to assemblages of fire intolerant species (Cooper 1960, Covington and Moore 1994; Belsky and Blumenthal 1997, Mast et al. 1999). In addition to fire danger, these changes have led to poor nutrient cycling and have altered wildlife community composition.

Forest restoration treatments target reducing tree stand densities and forest floor fuel loads through selective cutting and prescribed burning. Such treatments will result in more open, park-like forests with an understory of herbs and grasses rather than flammable organic litter. It is believed these forests will better sustain natural processes like periodic, cool fires and nutrient cycling, and not promote catastrophic fire or threaten old-growth trees.

However, sharp debate and controversy exist due to the lack of knowledge of both the effectiveness of wildland-urban interface (WUI) wildfire reduction treatments and their corresponding effects on wildlife. While restoration treatments won't result in truly "restored" forests for decades or longer, they are expected to drastically alter the structure and composition of treated stands. In this regard, restoration treatments have the potential to affect the wildlife community living in the ponderosa pine forest in unknown ways. The expected increases in biodiversity and productivity at the herbaceous layer should be immediately exploited by some wildlife species. Conversely, other species rely on current forest structures that will be reduced by restorative treatments. Therefore, some species are expected to decline in treated areas unless adaptations are made to accommodate them. For these reasons, empirical data are needed regarding the effects of ecosystem restoration on all fauna within the ponderosa pine community so that true adaptive management can be applied to forest restoration efforts.

Justification and Need for Wildlife Monitoring and Research

As indicated above, forests have changed drastically in the past 100 years. Complicating matters is the fact that no historic, quantitative data exists against which to compare present wildlife population numbers and distributions. However, many proposed forest restoration treatments will cause rapid and drastic changes in forest structure (e.g. the reduction of tree stem densities on Mt. Trumbull by up to 85 percent). The degree and temporal rapidity of these changes has great potential to affect populations of wildlife in treated areas.

The primary subjects of controversy surrounding the Grand Canyon Forests Partnership fire risk reduction/forest health restoration treatments, as demonstrated in 6 administrative appeals and one lawsuit, are the efficacy of treatments and the effects of such treatments on wildlife. Larger-scale environmental opposition to fire risk reduction treatments in the urban interface is demonstrated by the recent filing of a Notice of Intent by the Center for Biologi-

cal Diversity to sue over urban interface projects and their perceived effects on threatened and endangered species.

To achieve success in implementing fire risk reduction projects in the urban interface, we must be able to demonstrate both the effectiveness of fuels reduction treatments *and* the corresponding effects on wildlife. Only by evaluating the relationships of key wildlife to various treatments can we responsibly inform the adaptive restoration process. Therefore, more detailed information on the effects of various restoration treatments on wildlife are needed to guide the discussion of the most desirable prescription or blend of prescriptions to restore WUI forests.

Limited wildlife response data have been available to date with which to inform and adapt optimal fire risk reduction/forest health treatment prescriptions. These data have come primarily from the Mt. Trumbull restoration project. While fire-risk reduction treatments planned for north of Kelly Canyon in the Kachina Village Restoration Block are similar to that applied at Mt. Trumbull, the majority of treatments planned for south of Kelly Canyon are dissimilar due to the retention of patches of understory trees, and the planned retention of buffers of untreated forest along canyon rims.

We (Arizona Game and Fish Department [AGFD], as partners in the Grand Canyon Forest Partnership) propose to monitor expected fire risk reduction treatments in two prescription types in the Kachina Village forest health and fire risk reduction block.

Mule Deer as a Monitoring and Indicator Species

Mule deer populations are in decline throughout the Western United States, and are considered a management indicator species in the Coconino N.F. and elsewhere (USDA 2000, Thomas et al. 1979). One factor leading to the decline of mule deer may be reduced abundance and quality of herbaceous ground cover associated with the over-dense forest conditions which now occur throughout the West. Mule deer can be an effective indicator of forest health because of their reliance on a mixture of open tree canopies with understory vegetation and dense hiding cover. Several studies have demonstrated the need for a mixture of adequate shrub and herbaceous vegetation and dense hiding cover to meet a variety of life history needs. The reduction in canopy closure as prescribed within Kachina Village Forest Health Project will allow for the return of valuable forage in the form of herbaceous and shrub cover, but it is not known whether these treatments will leave proper ratios of open:hiding cover for continued mule deer use. The relationships between mule life history and habitat are reviewed briefly below.

Existing Mule Deer Research and Implications to Forest Restoration

Little information currently exists about responses of mule deer with which to inform restoration efforts. Several studies have related specific activities of mule deer to habitat type and structure, and one study (Germaine 1998) compared the characteristics of mule deer bed and forage sites between forested areas in which restoration treatments had been applied and controls in which no recent management activity had occurred. Implications of these studies are discussed below.

Foraging

- Kufeld et al. (1988) found an inverse relationship between mule deer feeding activity and canopy cover in ponderosa pine forests.
- Patton (1974) found substantial increases in grass and forb production and deer use after thinning ponderosa forests.
- AGFD research at Mt. Trumbull has documented mule deer foraging in treated areas during the 1-2 years immediately following stand thinning, prescribed fire, and reseeding (Germaine and Germaine 1999). Treated units appear to have higher abundances of deer forage vegetation than untreated forest areas.

Hiding Cover

- Hiding cover is important for predator avoidance, especially during fawning (Trainer 1975). Fawn bed sites are often within more densely vegetated areas (Fox and Krausman 1994, Gerlach and Vaughan 1991). The removal of sufficient hiding cover could result in decreased fawn recruitment (Fox and Krausman 1994).

Thermal Cover

- Dense vegetation can provide relief from both extreme cold and extreme heat, minimizing thermal stress upon deer (Thomas et al. 1979, Parker and Gillingham 1990).

Bedding Sites

- The dense horizontal and vertical vegetation typical of deer bedding sites contributes to both hiding and thermal benefits (Smith et al. 1986).
- AGFD research at Mt. Trumbull has described specific characteristics of mule deer day beds, and has documented a marked decrease in available vegetative structure for mule deer day bed placement within treated areas. Mule deer day bed placement in treated areas at Mt. Trumbull has been limited to oak mots, which appear to be the only features where thermal and hiding cover needs for day bedding are retained in the years immediately following forest restoration treatments (Germaine 1998).

Fire Effects

- Fire has been considered beneficial to deer habitat. Carlson et al. (1993) and Hobbs and Spowart (1984) found increased deer forage quantity and quality after fire, and Stager and Klebenow (1987) documented increased use of pinyon-juniper woodlands by deer post fire. Kie (1984) reported increased use of pine-oak forests by deer after prescription burning.

Human Disturbance

- Mule deer are sensitive to human disturbance (Freddy et al. 1986, Yarmoloy et al. 1988) causing greater energy expediture and reduced reproduction. Adequate hiding cover can potentially reduce the stress of human-induced disturbance.

Economics

- Mule deer are an economically important game species in AZ and throughout the West. In 2001 there were 87,835 applications for mule deer or any antlered deer hunts in Arizona. Permits issued for these hunts generated $2,210,832 in resident license fees, and $317,119 in nonresident fees in Arizona this year. Millions more dollars are generated in Arizona each year from deer hunting-related purchases.

The decline of mule deer in the West has coincided with the general increase in forest canopy closure, fire suppression, and the reduction of understory vegetation. The deer-habitat-human interaction factors listed above demonstrate how mule deer population

trends and habitat use patterns can be an effective indicator of forest health and a useful monitoring tool. The Kachina block treatments have potential to enhance deer habitat quality. The Kachina Block treatment prescription will produce a different ratio of open forest for forage production and dense patches for hiding than that produced at Mt. Trumbull. Learning the responses of mule deer to different ratios of open forest/dense patches will enhance our ability to manage for the benefit of mule deer populations in Arizona.

Gaps in Knowledge of Mule Deer - Restored Forest Habitat Relationships

AGFD research at Mt. Trumbull provides the only information we are aware of to date documenting mule deer responses to ponderosa pine forest restoration treatments. This research has demonstrated a need to combine open-canopied forest to improve forage vegetation with patches of dense vegetation to meet bedding and fawning cover needs. Threshold ratios of these habitat components are not yet known, nor do we know how far from escape/hiding cover mule deer will forage in treated forests.

AGFD has also documented that mule deer use of the Trick Tank Unit at Mt. Trumbull, the first large unit to be completed, has shown a marked decline over the 3 years (1998 – 2000) since treatment (Fig. 1). Figure 1 correlates spring precipitation with mule deer summer use of this unit. In this figure we use spring precipitation as a proxy variable for ground cover vegetation since we have noted a strong correlation between spring rains and vegetation growth in treated units. We have not identified the specific factor(s) responsible for decreased mule deer use of this area. Possibilities include: short-term site fidelity is being replaced by avoidance of treated areas; deer are responding directly to varying levels of ground cover vegetation (associated with spring precipitation); forage quality has decreased each year since treatment for reasons not related to precipitation; or, the combination of habitat openness and intense human presence in the area has caused an avoidance response. These types of questions must be answered before we apply forest restoration treatments over broad expanses of forest landscape.

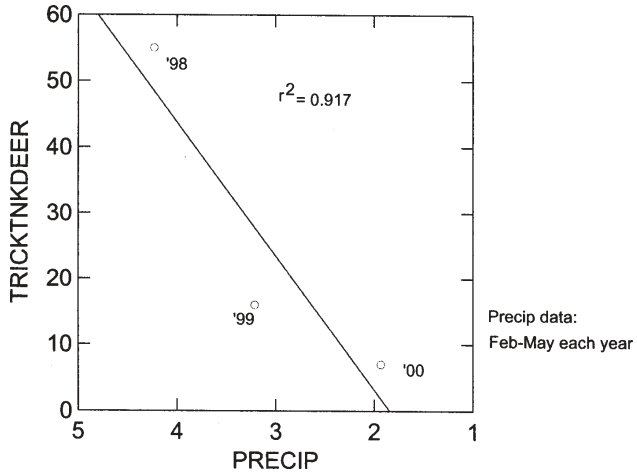

Figure 1. Mule Deer Use of Trick Tank Unit, Mt. Trumbull, During 3 Years Since Treatment, 1998-2000

The Kachina Village Forest Health Project is the second of 10 proposed ~4,000 ha planning units within the Flagstaff Wildland-Urban Interface (WUI), as part of the Grand Canyon Forests Partnership (USDA Forest Service 2000, 2001). This 4,217 ha project is located on the Mormon Lake and Peaks Ranger Districts, is located 6 km south of Flagstaff, includes the communities of Kachina Village and Forest Highlands, and will extend between Highways 89A and I-17 southward to the rim above Oak Creek Canyon.

Multiple thinning prescriptions are proposed in various treatment units in the Proposed Action for this project. While each prescription proposed has unique wildlife value and is therefore of research/monitoring interest, we propose to focus on two prescriptions which are extensive enough to ensure adequate samples may be generated, and which most closely represent WUI prescriptions likely to be applied throughout the west: "Thinning from Below – North of Kelly Canyon and Lower 89A Corridor" (hereafter TBN), and "Thinning from Below – South of Kelly Canyon" (hereafter TBS).

TBN will occur on 779 ha (1,923 ac) and will focus on reducing wildfire risk by both reducing ladder fuels and disconnecting the present continuous crown canopy. Post-treatment target tree densities range from 40-120 ft.^{2} basal area, canopy closure reduced to 40 to 50 precent, and mid-story canopy base height raised to an average of 15 ft. Small trees will be thinned around existing clumps of larger trees, maintaining existing spatial structures. Approximately 10 percent of the area will be managed as grassy openings located in areas where they were likely to have occurred in the past. Gambel oaks will not be cut.

TBS will occur on 674 ha (1,665 ac) south of Kelly Canyon and in the Mexican Pocket area. This area will be thinned with the objective of reducing wildfire risk in a manner similar to TBN but will also retain dense cover patches meant to enhance post-treatment wildlife value. Up to 25 percent of this area will be retained in dense clumps of understory trees with each clump exceeding 35 trees/clump, and clumps ranging in size from 0.04-0.4 ha (1/10th to 1 acre). Clumps will retain closed canopies with interlocking limbs and foliage. The forest surrounding clumps will be thinned to 40-100 ft.^{2} basal area. The combination of closed and open forest types proposed for TBS is expected to enhance wildlife value for species requiring dense patches of cover and those associated with ponderosa savannahs. Grassy openings and Gambel oaks will be managed in the same manner as in TBN.

Study Objectives

Our primary objective is to use mule deer as an indicator of the effects of two different thinning prescriptions (TBN, TBS) within the Kachina Village Forest Health Project. We will do so by collecting statistically reliable data comparing mule deer use of specific areas both pre- and post-treatment. The data collected will describe mule deer responses to thinning treatments, and will provide detailed and useful information which will help to guide future habitat management both locally and throughout the Southwest.

Objective 1: *Collect baseline pre-treatment data on mule deer habitat use and selection in both TBN and TBS Kachina Village Forest Health Project treatment areas.*

Procedure 1.1 - Pre-treatment data collection

In spring 2002, we will outfit up to 16 mule deer with telemetry collars with Global Positioning System (GPS) capabilities. Animals will be captured throughout the study area using a variety of proven methods, with 8 captured north and 8 south of Kelly canyon. Sixteen animals is a minimal number, to reduce cost, based on the recommendations (>20 animals) by Alldredge and Ratti (1986) and Leban (1999) for statistically powerful analyses.

GPS collars have several advantages over standard VHF telemetry collars:

After deploying the collars on animals, collection of location data is automated, requiring little effort in the field. Only periodic monitoring for mortality signals is required. Also, by eliminating presence of people in the field, the bias introduced by human disturbance from monitoring is eliminated.

Because of the automated nature of the collars, location data can be collected more frequently than with conventional collars, and the number of locations achievable (>1000/animal/year) far exceeds the capabilities of VHF collars. Data will be collected year-round, even when field conditions would prohibit standard VHF monitoring.

The locations produced by GPS collars are quite accurate (15m average). Acquiring locations this accurate with standard collars would require extensive and costly field technician labor.

Although initial cost of the collars is higher, overall cost per location is greatly reduced (<$2) because field technician labor time is effectively eliminated.

Collars will be configured to record a GPS fix every 7 hours, and retrieved when batteries are depleted or animal mortality is indicated. Collars will be configured to last 2 years and, therefore, provide up to 2 years of pre-treatment data depending on treatment implementation schedule.

Prior to scheduled collar expiration we will retrieve all collars while simultaneously placing new collars on the same deer. If we are unable to recapture deer, the collars will be removed from the animal via an automatic release buckle. The collar can then be retrieved on foot. We will then download collars into an AGFD GIS database, and prepare data for analysis of pre-treatment habitat selection preferences.

Because of the potential confounding effects of human disturbance, mostly within the TBN study area, vibration sensors will be installed along roadways at all boundaries of TBN and TBS treatments to index levels of human disturbance. Vibration sensors will be checked twice per week, separating weekdays and weekends. The relationship between deer location distance from roads and the level of human activity on roads will be examined graphically to determine a disturbance threshold. If a significant relationship is found, roadways exceeding the disturbance threshold will be buffered in the GIS to the threshold distance, and this area will not be considered available habitat.

Objective 2. *Collect post-treatment data on mule deer habitat use and selection in both TBN and TBS Kachina Village Forest Health Project treatment areas.*

Procedure 2.1 - Post-treatment data collection

The first spring after treatments have been fully completed (we anticipate 2005) we will outfit up to 16 mule deer with telemetry collars with Global Positioning System (GPS) capabilities. Collar configurations, data collection procedures, and data retrieval/downloading will be the same as described for pre-treatment above. **Note: Completing treatments in the shortest possible timeframe is important to minimize the degree of external influence on animals.*

Levels of human activity in post-treatment areas will be indexed and habitat availability buffered in the same manner as described for pre-treatment data collection, above.

An intern will be hired for one field season to help map the boundaries of all dense cover patches of trees retained after treatments with a GPS receiver.

Objective 3. *Compare selection preferences of mule deer for TBN and TBS habitats between pre- and post-treatment periods.*

Procedure 3.1 – Selection preference analysis

Four habitat types will be considered in this study: TBN, TBS, canyons (untreated), and other.

Total availability of each habitat type will be measured directly from GIS maps of the study area (generated by the Coconino N.F.). Using minimum convex polygons, home ranges as well as habitat availability for each animal will be identified.

Habitat use will be determined for each deer by comparing the proportional distribution of GPS locations to that available within each habitat type.

The *expected* number of locations for each habitat type will be the proportional equivalents of each available habitat.

Habitat selection analysis (Neu et al. 1974) will be used to test the following null hypothesis:

H_0**:** Habitat use (GPS locations) occurs in equal proportion to habitat availability.

Additionally, we will employ Bonferroni confidence intervals (Neu et al. 1974, Byers et al. 1984) to determine which habitats are selected or avoided and the strength of each demonstrated selection. These determinations will be made both pre- and post-treatment.

We will use Johnson' (1980) use-availability ranking method to index selection strength demonstrated by deer for each habitat type both pre- and post-treatment.

Finally, we will use a Mann-Whitney *U* test (Zar 1999) to test for differences in the selection ranking of each habitat type between pre- and post-treatment, under the null hypothesis:

H_0: Selection preferences displayed by mule deer for each habitat type do not differ between pre- and post-treatment.

In this regard it would be optimal to have the same deer telemetered both pre- and post-treatment. We do not anticipate that this is logistically possible, however, and will have a similar number of deer telemetered in each area during each study phase.

Finally, mule deer locations will be correlated with stand information on average dense cover patch size and patch density to determine whether a relationship exists for deer use of various stand types as defined by dense cover patches.

Benefits to Adaptive Management

While wildlife concerns continue to dominate professional and legal debates concerning WUI fire risk reduction and forest restoration, information on effects of treatments on wildlife remains extremely limited. Furthermore, true adaptive forest management cannot proceed in an informed manner without wildlife effects information. The information we propose to generate will directly address this problem. The results of this study will allow us to make better-informed management decisions regarding forest restoration and mule deer populations by providing information on TBN and TBS treatment prescriptions and mule deer use. This study will also provide additional information on ratios of foraging:bedding habitat suitable for mule deer, and ultimately will be of great value in guiding the placement of various treatment prescriptions on forest landscapes in WUI's and elsewhere.

Project Partners: Partners include the Coconino National Forest, Grand Canyon Trust, Arizona Game and Fish Department, and other members of the Grand Canyon Forests Partnership.

Budget

Year 1 (pre-treatment):

GS 20 Spec. III	1/12 time	$4,326.92
GS 19 Spec. II (develop study plan, initiate project)	1/2 time	$20,891.00
Overhead		$4,320.00
		$(29,537.92)
Initial deer capture		$12,800.00
Vehicle		$6,000.00
Equipment:	GPS collars	$50,000.00
	vibration sensors	$1,200.00
	computer supplies	$5,850.00
AOO (field supplies)		$2,000.00
Year 1 Total		$107,387.92

Year 2 (pre-treatment):

GS 19 Spec. II (analysis and reporting of pre-data)	1/2 time	$20,891.00
Overhead		$3,760.38
		$(24,651.38)
Vehicle		$6,000.00
AOO (field supplies)		$1,000.00
Year 2 Total		$31,651.38

Year 3 (1st year post-treatment):

Ps/ere		
GS 19 Spec. II (GPS cover patches)	1/2 time	$20,891.00
Intern (GPS cover patches)		$3,214.00
Overhead		$4,335.43
		$(28,440.43)
Refurbish GPS collars		$3,200.00
Replace GPS collars		$12,800
Vehicle		$6,000.00
AOO (field supplies)		$1,000.00
Year 3 Total		$51,440.43

Year 4 (post-treatment):

Ps/ere

GS 20 Spec. III	1/12 time	$4,326.92
GS 19 Spec. II (final analysis & reporting)	1/2 time	$20,891.00
Overhead		$4,535.60
		$(29,753.52)
Vehicle		$6,000.00
AOO (pub/pres costs)		$3,000.00
Year 4 Total		$38,753.52

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EVALUATING PONDEROSA PINE FOREST RESTORATION EFFECTS ON FOREST SONGBIRDS - A Monitoring Proposal - Emphasizing the Kachina Village Forest Health Restoration Project - Mormon Lake Ranger District, Coconino National Forest

Arizona Game and Fish Department
Research Branch
2221 W. Greenway Road
Phoenix, AZ 85023

September 1, 2001

Introduction

Logging, fire suppression, grazing activities, and climate changes over the past 150 years have drastically modified distribution, species composition and stand ages in ponderosa pine forests, resulting in general declines in forest health (Covington and Moore 1994). A proliferation of younger age class trees dominate forests today (Johnson 1994, Mast et al. 1999) with increased potential for catastrophic fire, disease, and decreased health of the ponderosa pine ecosystem (Covington and Moore 1994, Covington et al. 1997). These problems have spawned forest health restoration initiatives (Moore et al. 1999, Wagner et al. 2000) that advocate restoring ecosystem structure and function, using aggressive thinning of forests to improve tree growth, increase incidence of prescribed fire, and promote old-growth forest conditions (Covington and Moore 1994, Covington et al. 1997). The current threat of catastrophic fire to human safety and property in the Wildland-Urban Interface (hereafter WUI)—where homes and other human development interface with wildland vegetation—are of high concern to land managers, fire service personnel, property owners, and others.

However, sharp debate and controversy exist due to lack of knowledge of both effectiveness of WUI wildfire reduction treatments and their corresponding effects on wildlife. The primary subjects of controversy surrounding the Grand Canyon Forests Partnership fire risk reduction/forest ecosystem health treatments are the efficacy of treatments and the effects of such treatments on wildlife.

To address existing concerns, a suite of restoration prescriptions have been proposed for reducing wildfire risk in the WUI in the greater Flagstaff vicinity. While individual prescriptions to date have been derived from professional interpretations of historic pre-settlement forest conditions, each varies with respect to post-treatment densities of ponderosas and understory trees retained. These features will influence how well fire risk is reduced in the WUI and what type of wildlife species are supported in treated areas.

Wildlife response data are extremely limited to help formulate treatment prescriptions that support greater wildlife species diversity. To achieve success in implementing fire risk reduction projects in the WUI, we must be able to demonstrate both the effectiveness of fuels reduction treatments and maintain viable breeding populations of all native wildlife.

Justification and Need for Wildlife Monitoring and Research

Debate and controversy abounds due to lack of knowledge of the effectiveness of WUI catastrophic wildfire reduction treatments and their corresponding effects on wildlife. The primary subjects of controversy surrounding the Grand Canyon Forests Partnership fire risk reduction/forest health restoration treatments, as demonstrated in 6 administrative appeals and 1 lawsuit, are the efficacy of treatments and the effects of such treatments on wildlife. Larger-scale environmental opposition to fire risk reduction treatments in the urban interface is

demonstrated by the recent filing of a Notice of Intent by the Center for Biological Diversity to sue over urban interface projects and their perceived effects on threatened and endangered species.

To optimize success in implementing fire risk reduction/forest health projects in the urban interface, we must be able to demonstrate both the effectiveness of fuels reduction treatments and the corresponding retention of native wildlife. Limited wildlife response data are available to help inform optimal fire risk reduction/forest health treatment prescriptions; these have come primarily from the Mt. Trumbull restoration project. While fire-risk reduction treatments planned for north of Kelly Canyon in the Kachina Village Restoration Block appear similar to that applied at Mt. Trumbull, the majority of treatments planned for south of Kelly Canyon are dissimilar due to the retention of patches of understory trees, and leaving buffers of untreated forest along canyon rims.

Wildlife species are expected to respond differently to each treatment prescription, and only by evaluating the relationships of key wildlife to various treatments can we inform the adaptive restoration process. Hard information on the effects of various restoration treatments on wildlife are needed to guide the discussion of the most desirable prescription or blend of prescriptions to restore WUI forests. We (Research Branch, Arizona Game and Fish Department [AGFD], as partners in the Grand Canyon Forest Partnership) propose to monitor expected fire risk reduction treatments in two prescription types in the Kachina Village forest health and fire risk reduction block.

Forest Songbirds as Monitoring and Indicator Species

Songbirds are powerful management indicators because many individual species are highly habitat and structure-specific (McArthur and McArthur 1961, James 1971, Rosenstock 1998). Songbirds are in decline throughout the Western Hemisphere, primarily due to habitat degradation on breeding, migration, and wintering grounds (Terborg 1989a). Restoration treatments may drastically alter forest structure in a short time, and are expected to increase prey abundance for songbirds at ground level, and to decrease amounts of foraging and nesting substrate in the mid- and over-story canopy. These changes to forest structure have great potential to alter songbird community composition and habitat availability. Therefore, it is essential to identify species retained in areas receiving different treatment prescriptions so we can best manage for viable breeding populations of all native songbird species on forest landscapes.

Forest songbirds are well suited for indicating effects of forest restoration treatments, for comparing responses among different treatment prescriptions, and for informing the adaptive management process, because:

- Many species of forest songbirds are obligates of pine and mixed conifer forests and of distinct structural (VSS) stages (Szaro and Balda 1986, Rosenstock 1996, Moir et al. 1997). Songbird species partition habitat from ground level through overstory canopy, and these habitat relationships may change during breeding, migration, and winter seasons. Because of the high level of structural specificity of many songbird species during different seasons, forest songbirds make excellent indicators of habitat structural diversity.
- Forest songbirds are highly responsive to changes in ponderosa forest structure and composition, with several species demonstrating marked population changes as ponderosa forests have been altered since circa 1910 (reviewed by Scurlock and Finch 1997).
- Songbird populations are influenced by factors at the micro-habitat, stand, and landscape scales.
- Many species of forest songbirds are abundant and widespread in ponderosa forests, making collection of robust data sets relatively inexpensive and efficient. This allows analytically powerful comparisons among habitat types, treatment prescriptions, and of pre- and post-treatment effects.
- Once collected, bird community data can be easily parsed into examinations of individual species responses, responses of select indicator species, as guilds defined by nesting or foraging habitat-use traits, or as entire communities.
- A broad base of published knowledge exists on the effects of various logging practices and of fire on songbird populations (Finch et al. 1997), affording predictions to be formulated and tested

about responses of individual songbird species to specific prescriptions. Testing *a-priori* predictions has many advantages over conducting purely descriptive or comparative studies, the foremost being clearer understanding of implications of specific management actions.

Existing Forest Songbird Research and Implications to Forest Restoration

Forest changes over the past 150 years have undoubtedly resulted in geographic scale shifts in abundance for many species of forest songbirds. Scurlock and Finch (1997) reviewed songbird surveys from 1911, 1928, and 1961 and report numerous species have either increased or decreased in abundance and distribution during this time. They attribute this to changes in forest structure associated with human activity since before Euro-American settlement of the region.

Responses of songbirds to restoration treatments are generally expected to reflect a shift back toward pre-settlement community composition. However, treated forests won't have pre-settlement old-growth characteristics for decades or longer, and appropriate habitat structure must be retained on the landscape to ensure retention of viable populations of all songbirds until treated areas attain old-growth characteristics. Furthermore, identification of particular habitat structures (e.g. snags, thickets) required to retain various songbird species in restoration-treated settings is necessary to inform the adaptive management process for forest restoration.

We are aware of only three studies (Beier 1998, Germaine 1999, Gilihan 2000) that have examined songbird communities in the context of ponderosa forest restoration in the Southwest. However, other studies have examined responses of breeding and non-breeding songbirds to common silvicultural prescriptions and among ponderosa age, size, and vegetative structural stage classes in the Southwest. Data from these studies are valuable for predicting responses of various species and guilds to ponderosa forest restoration treatments.

- Beier (1998) collected 3 years' data on breeding bird abundance in ponderosa forest preceding restoration treatments at Mt. Trumbull, Arizona. He reported white-breasted nuthatch, grace's warbler, mountain chickadee, pygmy nuthatch, and western tanager as the five most abundant species during the breeding season, and noted brown-headed cowbirds as rare but present. Beier (1998) also noted a preference by cavity nesters for snags, and six bird species that demonstrated a preference for nesting in the largest trees available.
- Germaine (1998) and Germaine and Germaine (1999, 2000) also worked at Mt. Trumbull, and collected 2-years' pre-treatment data on birds during the spring ('98-'99) and fall ('99-'00) migration periods. The most abundant birds recorded during spring migration were mountain chickadee, yellow-rumped warbler, Grace's warbler, Steller's jay, white-breasted nuthatch, western tanager, and dark-eyed junco; the most abundant birds during fall migration were Steller's jay, white-breasted nuthatch, mountain chickadee, dark-eyed junco, and western bluebird. Germaine (1998) noted that sagebrush openings and pinyon-juniper stands appeared to support the lowest abundance of migrants, while areas containing deciduous trees supported the highest abundance and diversity of migrants. Germaine (unpub. Data) also noted that overall bird abundance appeared higher during fall than in spring.
- Gillihan (2000) examined short-term responses of breeding birds to small (~ 40 ha) restoration plots on the San Juan National Forest in southwestern Colorado. He noted birds that were only found in untreated forest (mourning dove, brown creeper, hermit thrush, black-headed grosbeak, band-tailed pigeon, northern flicker, olive-sided flycatcher), while others (northern goshawk, downy woodpecker, ruby-crowned kinglet, plumbeous vireo, orange-crowned warbler) were only found in treated areas.
- All three studies noted the presence of brown-headed cowbirds, and Germaine (unpub. Data) and Gillihan (2000) both noted higher abundances of cowbirds in natural openings and treated areas than in untreated forest. These observations are important because nest parasitism by cowbirds has caused significant declines in some host species (Terborg 1989b).

Some general trends were noted in these and other studies:

- Bird diversity was higher in ponderosa forests that had a deciduous component, usually Gambel oak or aspen (Mannan and Seigel 1988, Rosenstock 1998, Gillihan 2000).
- Bird community composition differed between dense and more open forest stands (whether natural or silviculturally derived), with increases in ground foraging and open area birds (chipping sparrows, Cassin's finches, western bluebirds and several flycatchers) and decreases in dense canopy or bark substrate foragers and nesters (western flycatcher, pygmy nuthatch, hermit thrush, black-headed grosbeak, red-faced and Grace's warblers) as forests became more open (Szaro and Balda 1979, 1986, Blake 1982, Mannan and Seigel 1988, Gillihan 2000). In general open forests had increased abundances of granivores and open-aerial foragers and decreases in coniferous mid and overstory nesters and canopy and bark foragers.
- Bird density peaked in lightly thinned stands and was lower both in uncut areas and areas opened to the extent planned for restoration treatments in the WUI (Szaro and Balda 1979, 1986).
- Several forest bird species demonstrated preferences for trees with old-growth characteristics, if available (Mannan and Seigel 1988, Beier 1998).
- Several forest bird species were less abundant or absent from forest stands that had been silviculturally thinned or burned and contained no large trees demonstrating old-growth characteristics (Mannan and Seigel 1988, Szaro and Balda 1979, 1986, Blake 1982).

Gaps in Knowledge of Forest Songbirds and Restored Forest Habitat Relationships

Limited information exists to date on songbird responses specifically to ponderosa restoration treatments. Existing studies in ponderosa forests have demonstrated that birds respond to forest thinning at both the population and community levels, and suggest that forest restoration will affect birds during the breeding, migration, and winter seasons. Different restoration prescriptions will retain different habitat features (e.g. varying ponderosa tree densities and diameters, volume of midstory coniferous canopy, etc.), and will, therefore, likely retain songbird species in different abundances. Songbird species diversity is highly dependent on habitat structural diversity (MacArthur and MacArthur 1961), and restoration prescriptions that homogenize landscapes are likely to support fewer species than those that strive for structural heterogeneity. Therefore, gaining and integrating information from a wide spectrum of restoration treatments and seasons is vital to our ability to manage for viable forest songbird populations in restored forest settings.

Breeding Songbirds

Breeding songbirds have specific habitat requirements for nesting and feeding (Szaro and Balda 1986, Rosenstock 1996) and are highly mobile, making them good indicators of habitat quality. However, it is not know where thresholds in appropriate habitat exist, and beyond which some species may not be retained. This is an important considersation because existing restoration prescriptions will alter forest habitats drastically and in a short period of time. Treatment prescriptions that aggressively open forest canopies may replace forest-interior birds species with ground foraging and aerial flycatching species, but consideration to volume and clumpiness of post-treatment coniferous canopy may cause more forest-interior species to be retained. Therefore, it is important to identify breeding bird species retained in each treatment prescription so that future prescriptions may be applied in a coordinated manner allowing retention of all breeding birds on our forest landscapes.

Migrating and Wintering Songbirds

Habitat requirements of passerine birds during spring and fall migration are poorly understood, but are known to include sites that afford high quality foraging, predation avoidance, and roosting habitats (Rappole 1995). Most long distance migrants require highly specific types of stopover habitat, with a large number of species using forested habitats (Rappole 1995). Different restoration treatment prescriptions are expected to vary in amounts of insects, seeds, and fruits available and in amount and type of foraging substrates retained in the lower, mid, and over-story canopy. These changes in prey base and forest structure have a great potential to

alter the community composition and habitat use of both wintering and spring and fall migrant bird assemblages, but we do not yet know the relationship between different prescriptions and songbird assemblages in these seasons.

Kachina Village Forest Health Project

The Kachina Village Forest Health Project is the second of 10 proposed ~4,000 ha planning units within the Flagstaff Wildland-Urban Interface (WUI), as part of the Grand Canyon Forests Partnership (USDA Forest Service 2000, 2001). This 4,217 ha project is located on the Mormon Lake and Peaks Ranger Districts, is located 6 km south of Flagstaff, includes the communities of Kachina Village and Forest Highlands, and will extend between Highways 89A and I-17 southward to the rim above Oak Creek Canyon.

Multiple thinning prescriptions are proposed in various treatment units in the Proposed Action for this project. While each prescription proposed has unique wildlife value and is therefore of monitoring interest, we propose to focus on two prescriptions which are extensive enough to ensure adequate samples may be generated, and which most closely represent WUI prescriptions likely to be applied throughout the West: "Thinning from Below – North of Kelly Canyon and Lower 89A Corridor" (hereafter TBN), and "Thinning from Below – South of Kelly Canyon" (hereafter TBS).

TBN will occur on 779 ha (1,923 ac) and will focus on reducing wildfire risk by both reducing ladder fuels and disconnecting the present continuous crown canopy. Post-treatment target tree densities range from 40-120 ft^2 basal area, canopy closure reduced to 40 to 50 percent, and mid-story canopy base height raised to an average of 15 feet. Small trees will be thinned around existing clumps of larger trees, maintaining existing spatial structures. Approximately 10 percent of the area will be managed as grassy openings located in areas where they were likely to have occurred in the past. Gambel oaks will not be cut.

TBS will occur on 674 ha (1,665 ac) south of Kelly Canyon and in the Mexican Pocket area. This area will be thinned with the objective of reducing wildfire risk in a manner similar to TBN but will also retain dense cover patches meant to enhance post-treatment wildlife value. Up to 25 percent of this area will be retained in dense clumps of understory trees with each clump exceeding 35 trees/clump, and clumps ranging in size from 0.04-0.4 ha ($1/10^{th}$ to 1 ac). Clumps will retain closed canopies with interlocking limbs and foliage. The forest surrounding clumps will be thinned to 40-100 ft^2 basal area. The combination of closed and open forest types proposed for TBS is expected to enhance wildlife value for species requiring dense patches of cover and those associated with ponderosa savannahs. Grassy openings and Gambel oaks will be managed in the same manner as in TBN.

Objectives of this Proposal

The Proposed Action for the Kachina Village Forest Health Project includes a *Purpose and Need* to "research and demonstrate key ecological.....dimensions of forest health improvement efforts" (page 10) and *Administrative and Strategic Direction* to "encourage research and monitoring....to evaluate the effects of the project" (USDA Forest Service 2001; page 3). We have described why forest songbirds are an excellent choice for evaluating the effects of restoration treatments planned for the Kachina Village Block, and propose to collect reliable data with which to demonstrate songbird responses to restoration and with which to compare effects of this treatment prescription to other existing prescriptions (e.g. those at Mt. Trumbull, Fort Valley, etc.). Our objectives are to monitor breeding and non-breeding songbirds in each treatment prescription to identify the ability of songbird species to persist among various treatment types. This monitoring will result in reliable information and recommendations for restoration applications within the Flagstaff WUI and elsewhere in ponderosa forests in the Southwest.

Specific Objectives:

- To compare pre- and post-treatment songbird communities among areas:
    - scheduled to receive thinning-from-below restoration treatments that do not retain dense cover patches (TBN);
    - scheduled to receive thinning-from-below restoration treatments that retain dense cover patches (TBS, as described above);
    - adjacent areas of similar vegetation to serve as controls;
    - near (< 150 m) and far (>250 m) from untreated canyon forest habitat; and,
    - containing low (< 25 percent of expected range) and high (>75 percent of expected range) percent composition of Gambel oak presence.

Design and Procedures

Objective 1: *To survey songbird communities in pre-treatment and control areas during winter, migration, and breeding periods.*

Procedure 1.1 - Pre-treatment songbird data collection

a. We will conduct modified point counts (area-constrained surveys) at 150 points distributed evenly among TBN, TBS, and Control (CTRL) forest habitat during spring migration (April-early May), breeding season (late May-early July), and winter (Jan-Feb) of 2002-2003, contingent upon project implementation scheduling and available funding. Survey points will be separated by ≥200 m, will be >100 m from the treatment edges (other than canyons, described below), and will be surveyed between 0530 and 1000 hours for breeding birds, and 0630 and 1200 hours for migrating and wintering birds, on days with minimal wind and no precipitation. Three visits of 8 minutes duration each will be made to each point during each survey period, with recorded survey data constrained to within 75 m of each point.

b. Species of, and distance to each individual bird detected visually or aurally will be recorded during surveys by field technicians experienced in bird censusing. Abundance values for each species at each point in each season will be the highest number of individuals recorded during any of the three visits/season.

c. Data will be summarized within each seasonal survey period, and will consist of evenness within guilds, with guilds defined by foraging and nesting substrate use. Both guild and indicator species analysis suffer the possibility of misrepresenting member species. Therefore, intra-guild membership and relative abundance of each species will be tracked among CTRL, TBN, and TBS.

d. In each forest type (TBN, TBS, CTRL), survey points will be distributed such that 25 points fall within 150 m of canyon edges and 25 points fall beyond 250 m from canyon edges. Contingent upon our ability to find areas having a Gambel oak basal area >10 and areas having no oak within each distance class (near and far from canyons), survey points will be distributed such that 12-13 in each distance class are in stands containing Gambel oak and 12-13 points in areas containing no Gambel oak. All points will be placed to avoid the influence of pre-existing meadow openings.

Objective 2: *To describe habitat characteristics among pre-treatment forest types.*

Procedure 2.1 – Measure pre-treatment habitat characteristics

a. To determine pre-treatment forest structural conditions influential to forest songbirds we will measure forest structural characteristics on all treatment and control survey plots in 0.1 ha (.25 ac) plots centered on survey points. We will measure diameter at breast height (dbh) of all trees >2.5 cm dbh in two 6 m wide belts running N-S and E-W across plots. We will record percent deciduous, coniferous, midstory, and overstory canopy closure at 40 points distributed about the plot, and will index ground cover vegetation density ≤2.5 m in height using a density board. These measurements will be made for describing pre-existing differences among treatment and control areas, and will not be used in analyses of bird variables among treatment/control areas.

Objective 3: *To survey songbird communities in post-treatment and control areas during winter, migration, and breeding periods.*

Procedure 3.1 – Post-treatment songbird data collection

a. Bird survey and vegetative data will be collected during the first 2 years post-treatment at the same points and in the same manner as described in Procedure 1.1.

Objective 4: *To describe post-treatment habitat characteristics among treatment types.*

Procedure 4.1 – Measure post-treatment habitat characteristics

a. To determine post-treatment forest structural conditions pertinent to forest songbirds we will measure forest structural characteristics on all treatment and control survey plots in the same manner as

described in Procedure 2.1. Again, these measurements will be made for describing differences among post-treatment and control areas, and will not be used in analyses of bird variables among treatment/control areas.

Objective 5: *To compare effects of TBN and TBS restoration treatments to control areas.*

Procedure 5.1 – Assess effects of restoration treatments on TBN, TBS, and CTRL areas.

a. For bird guilds, the difference between TBS pre-treatment – TBS post-treatment, TBN pre-treatment – TBN post-treatment, and CTRL pre-treatment – CTRL post-treatment will be examined in an ANOVA modification of the B-A-C-I-P (Stewart-Oaten et al. 1992) design. The ANOVA will include tests for interaction effects among treatment type x distance from untreated canyon habitat and treatment type x oak composition, under:
    a. Ho1: the difference between pre- and post-treatment songbird guild membership is equal among TBN, TBS, and CTRL areas; and,
    b. Ho2: no interaction effects among treatment type, distance from canyon habitat, or oak composition.

Benefits to Adaptive Management

While wildlife concerns continue to dominate professional and legal debates concerning WUI fire risk reduction and forest restoration, information on effects of treatments on wildlife is presently extremely limited. The information we propose to generate will directly address this problem. Further, true adaptive forest management cannot proceed in an informed manner without wildlife effects information. The information we propose to generate will enlighten debates on compatibilities and incompatibilities between individual treatment prescriptions and numerous response groups of wildlife, will identify wildlife species warranting concern in future treatments, and ultimately will be of great value in guiding the placement of various treatment prescriptions on forest landscapes, in WUI's and elsewhere.

Project Partners: Partners include the Coconino National Forest, Grand Canyon Trust, Arizona Game and Fish Department, and other members of the Grand Canyon Forests Partnership.

Budget

While we feel it is important to collect songbird information during the three seasons described in this document, we present funding options for including 1, 2, or all 3 proposed survey seasons.

Funding Alternatives

Year 1	Breeding	Breed & Spring	Breed, Spring, Winter
GS 20 Spec. III	$3,784.86	$3,784.86	$3,784.86
GS 19 Spec. II	$15,078.00	$23,694.00	$30,874.00
GS 16 Technician	$3,727.50	$7,455.00	$8,520.00
Overhead	$3,000.05	$4,639.29	$5,734.24
Vehicle	$4,000.00	$5,000.00	$6,000.00
AOO	$2,000.00	$2,000.00	$2,000.00
Equipment	$5,850.00	$5,850.00	$5,850.00
Year 1 Total:	$37,440.36	$52,423.15	$62,763.10
Years 2 & 3			
GS 20 Spec. III	$3,784.86	$3,784.86	$3,784.86
GS 19 Spec. II	$15,078.00	$23,694.00	$30,874.00
GS 16 Technician	$3,727.50	$7,455.00	$8,520.00
Overhead	$3000.05	$4,639.29	$5,734.24
Vehicle	$4,000.00	$5,000.00	$6,000.00
AOO	$2,000.00	$2,000.00	$2,000.00
Year 2:	**$31,590.41**	**$46,573.15**	**$56,913.10**
Year 3:	**$31,590.41**	**$46,573.15**	**$56,913.10**
Year 4			
GS 20 Spec. III	$3,784.86	$3,784.86	$3,784.86
GS 19 Spec. II	$37,336.00	$37,336.00	$37,336.00
GS 16 Technician	$3,727.50	$7,455.00	$8,520.00
Overhead	$5,955.96	$6,450.98	$6,592.41
Vehicle	$4,000.00	$5,000.00	$6,000.00
AOO	$3,500.00	$3,500.00	$3,500.00
Total:	$58,304.32	$63,526.84	$65,733.27

* We are investigating the possibility of using Northern Arizona Audubon members to assist in bird surveys, at a cost reduction of up to $10,000/yr. However, we are weighing savings versus scientific data collection quality tradeoffs.

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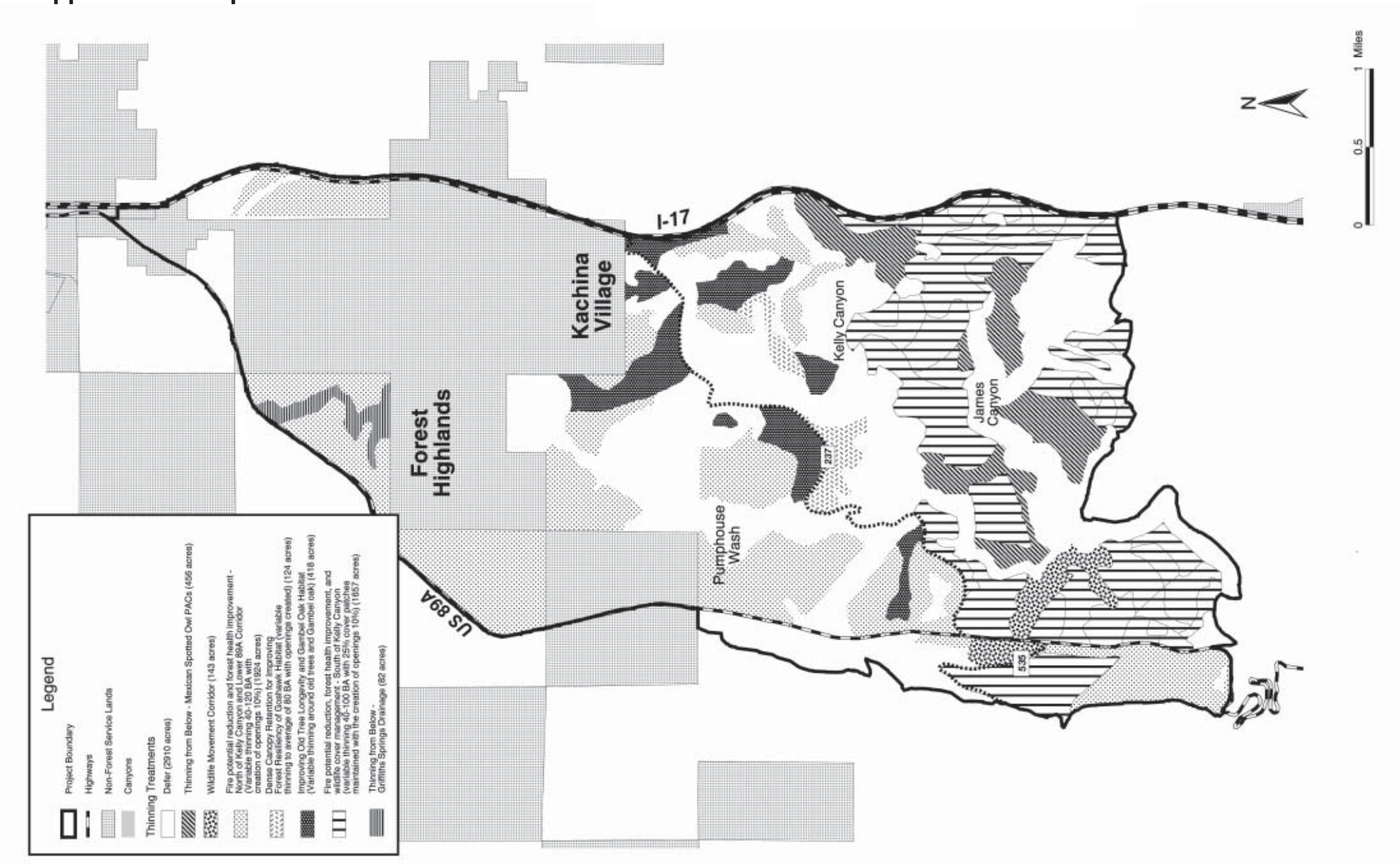
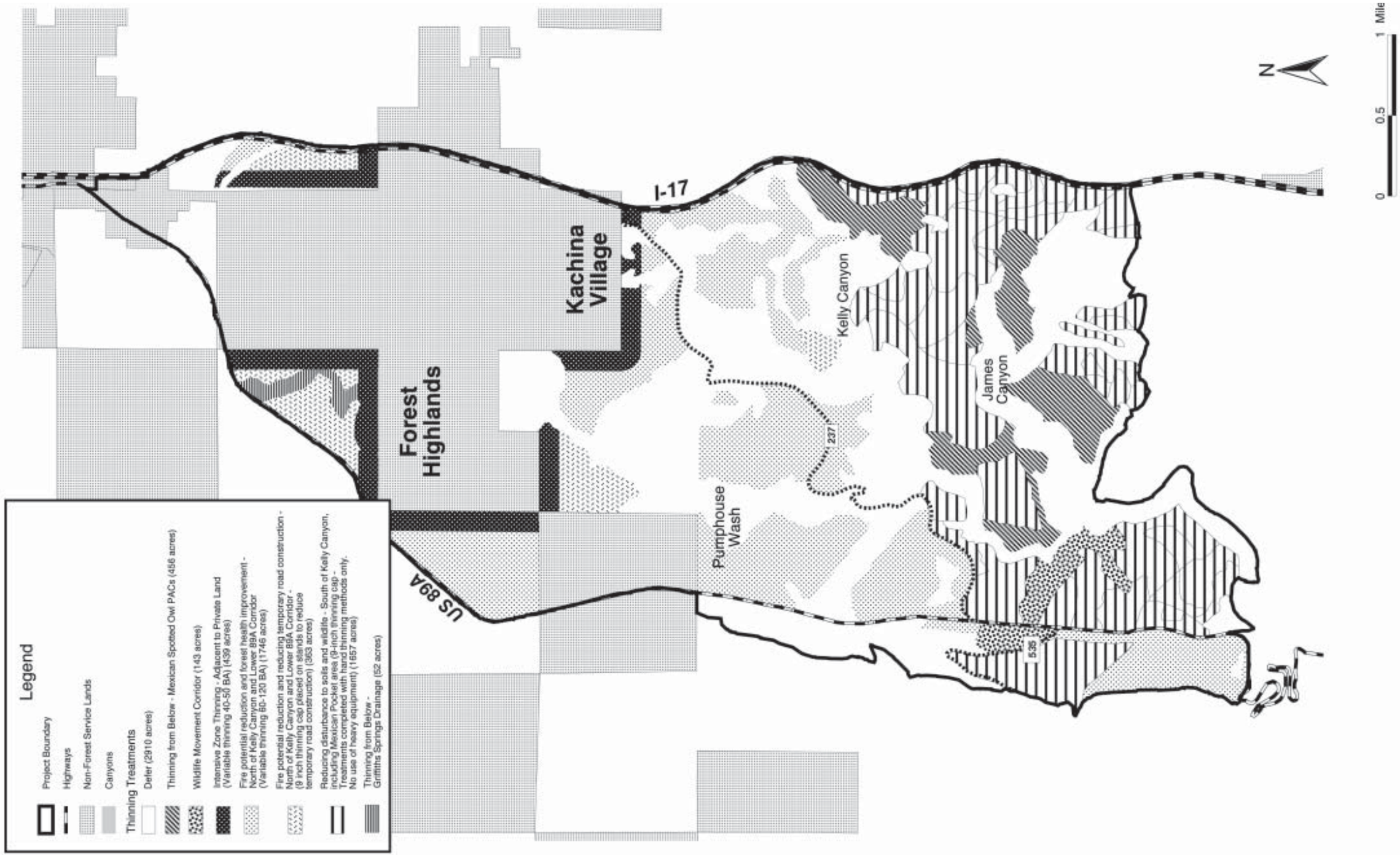
Appendix C • Maps

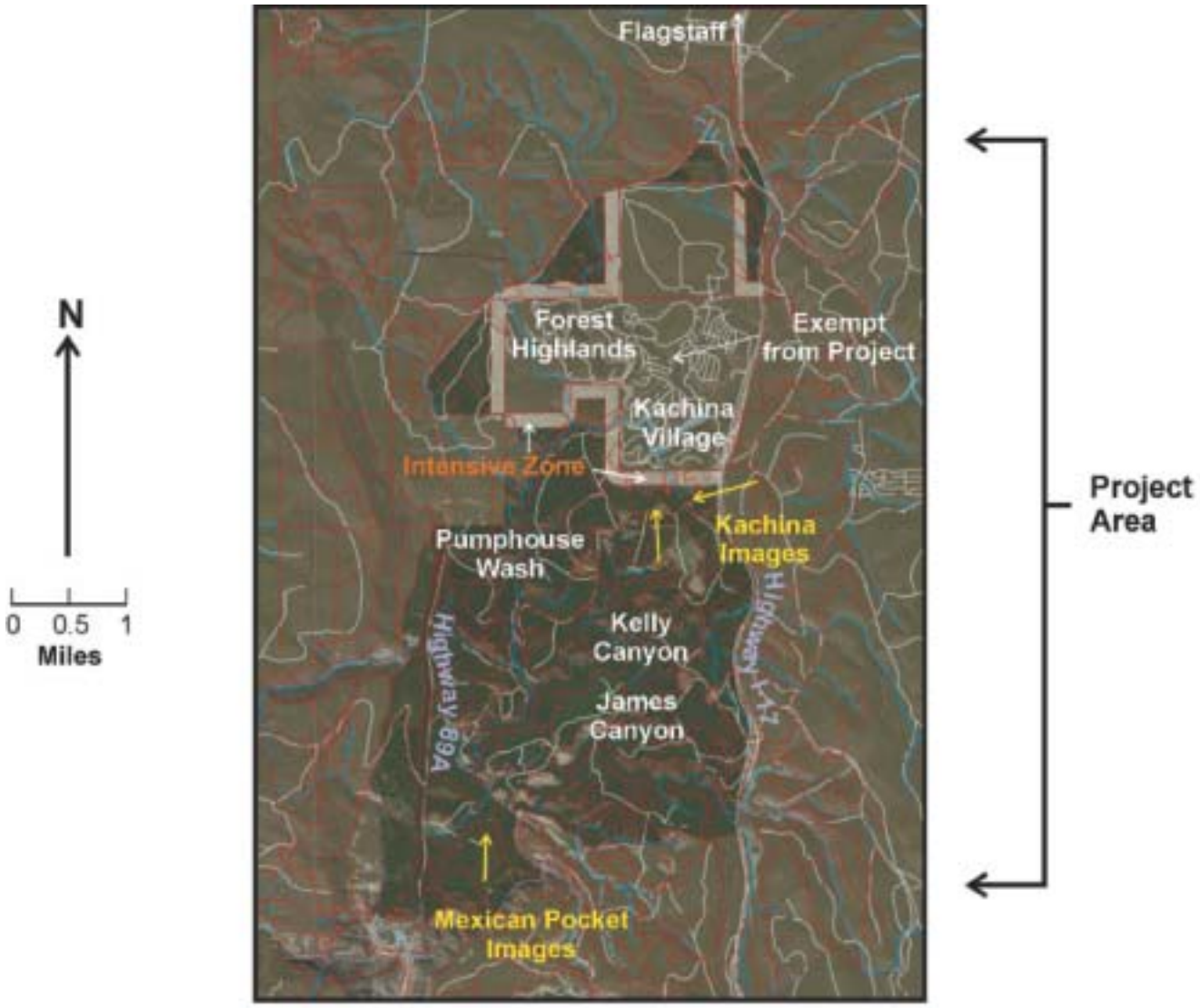


Alternatives A, C and D thinning.



Alternative E thinning.

Appendix D • Visual Simulation Report



Kachina Village Forest Health Project Visual Simulation
March 3, 2002

RDI Resource Design Inc
Forest and Land Planning Services

Fig. 1

20 trees per acre

40 trees per acre

60 trees per acre

Lower Retention Thinning with Ground Vegetation

80 trees per acre

100 trees per acre

120 trees per acre

202 trees per acre (existing)

Greater Retention Thinning with Pine Straw Ground Cover

Computer Simulation of Density Thinning Comparisons and Related Ground Cover

Kachina Village Forest Health Project Visual Simulation
March 3, 2002

RDI Resource Design Inc
Forest and Land Planning Services

Fig. 2

20 trees per acre

40 trees per acre

60 trees per acre

Lower Retention Thinning with Ground Vegetation

80 trees per acre

100 trees per acre

120 trees per acre

202 trees per acre (existing)

Greater Retention Thinning with Pine Straw Ground Cover

Computer Simulation of Density Thinning Comparisons and Related Ground Cover
Aerial Oblique

Kachina Village Forest Health Project Visual Simulation
March 3, 2002

RDI Resource Design Inc
Forest and Land Planning Services

Fig. 3

Existing Condition

Alternative ACD

Alternative E

Mexican Pocket Aerial Oblique Views

Kachina Village Forest Health Project Visual Simulation
March 3, 2002

RDI Resource Design Inc
Forest and Land Planning Services

Fig. 4

Existing Condition

Alternative ACD

Alternative E

Mexican Pocket Close-up
Aerial Oblique Views

Kachina Village Forest Health Project Visual Simulation
March 3, 2002

RDI Resource Design Inc
Forest and Land Planning Services

Fig. 5

Kachina Village Area - Aerial Oblique View

Alternative E - randomized placement

Alternative E - uniform placement (15' x 15')

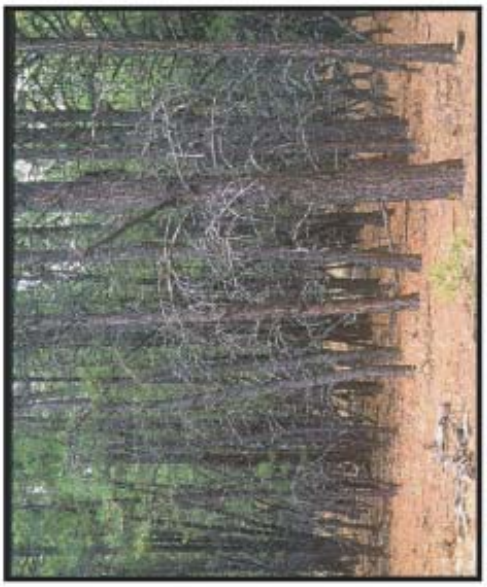
Existing Condition

Alt. ACD - with small patch removal
no high density retention

Kachina Village Forest Health Project Visual Simulation
March 3, 2002

RDI Resource Design Inc
Forest and Land Planning Services

Fig. 6



Existing Condition

Thinned Stand

Existing Condition

Kachina Project Area Photos
Tamera Randell, 2002

Kachina Village Forest Health Project Visual Simulation
March 3, 2002

RDI Resource Design Inc
Forest and Land Planning Services

Appendix E • Key Standards and Guidelines, Coconino National Forest Land Management Plan

The general standards and guidelines that were key to developing the Kachina Village Forest Health Project are described here, however, this is not an entire list of standards and guidelines of the Forest Plan. Standard and guideline compliance reports for the Proposed Action are located in the project record file (Chapter L). Key standards and guidelines include:

- Hold fires to 10 acres or less per fire start. The zone is the WUI and an area up to 10 miles long in a southwesterly direction from WUI areas (Coconino National Forest Plan, 1996, p. 93).
- "...high intensity crown fires are not acceptable in [northern goshawk] post-family fledging family areas or nest areas." (Coconino National Forest Plan, 1996, p. 65-11.)
- Work toward the recovery and de-listing of threatened and endangered species (Coconino National Forest Plan, 1996, p. 23). "Heavy accumulations of ground and ladder fuels have rendered many south-western forests vulnerable to stand-replacing fires...reduce these fuels and abate fire risks" (Mexican Spotted Owl Recovery Plan).
- Standards for northern goshawk habitat call for sustaining a mosaic of vegetative densities (overstory and understory), age classes, and species composition across the landscape. (Coconino National Forest Plan, 1996, p. 65-7).
- Strive to create or sustain as much old-growth compositional, structural, and functional flow as possible over time at multiple-area and scales (Coconino National Forest Plan, 1996, p. 70-1).
- Northern goshawk habitat: Manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape (Coconino National Forest Plan, 1996, p. 65-7).
- Follow distribution of age/size tree classes per habitat guidelines for the Mexican spotted owl and the northern goshawk (Coconino National Forest Plan, 1996, pp. 65-1 to 65-11).
- Seek to develop or retain old-growth function on at least 20 percent of the naturally forested area by forest type in any landscape (Coconino National Forest Plan, 1996, p. 70-1).
- For Mexican spotted owl Restricted Habitat: Attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes...Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure (Coconino National Forest Plan, 1996, p. 65-4).
- Manage habitat to maintain viable populations of wildlife and fish species and improve habitat for selected species (Coconino National Forest Plan, 1996, p. 22-1).
- ROS classes are used in developing decisions on road standards and density. Total acres of any ROS class are allowed to change no more than +/- 15 percent from the updated inventoried levels during the first decade (Coconino National Forest Plan, 1996, p. 51).
- Emphasize maintaining some thermal cover in known wildlife corridors and bedding areas (Coconino National Forest Plan, 1996, p. 124).
- Dispersed areas are kept clean for aesthetics, health, and safety. Areas damaged to use are closed and restored as necessary (Coconino National Forest Plan, 1996, p. 57).
- Criteria for closures to off-road driving are described on pages 58-59 of the Coconino National Forest Plan (1996) and include sensitive soils, wildlife, visual quality, water quality, and wetlands.
- Maintain current satisfactory watershed conditions and improve any unsatisfactory conditions to satisfactory by 2020 (Coconino National Forest Plan, 1996, p. 74).
- At least 25 percent of those riparian areas currently classified as "unsatisfactory" will be in satisfactory condition by 2000 (Coconino National Forest Plan, 1996, p. 73).

- "...areas may be seasonally closed to provide opportunities for recreation in a setting...toward the primitive end of the [ROS] spectrum" (Coconino National Forest Plan, 1996, p. 59).
- "Implement off-road driving restrictions in areas where roads are closed or obliterated...to prevent reopening..." (Coconino National Forest Plan, 1996, p. 60).
- Northern goshawk habitat: Manage road densities at the lowest level possible (Coconino National Forest Plan, 1996, p. 65-11).
- Manage road densities to achieve an average of 2 miles per section in the ponderosa pine/mixed conifer zone (Coconino National Forest Plan, 1996, p. 89).
- Evaluate the extent to which insect and disease control measures are needed to protect either the suitable [timber base] or unsuitable areas (Coconino National Forest Plan, 1996, p. 70).

Appendix F • Landscape Character

Landscape character analysis is mostly concerned with long-term, indirect effects of landscape management activities. The landscape character issue relevant to the Kachina area analysis is the extent to which changes in forest composition, such as those proposed in the EIS, will affect the inherent aesthetic qualities of the area landscape.

The landscape of the Kachina Project area lies completely within the "Flagstaff Character Type" zone, a contiguous geographic area with common visual characteristics resulting from common ecological characteristics. Scenic characteristics identified for the Flagstaff Character Type in general and which occur within the Kachina Project area are outlined in *Landscape Character Types of the National Forests in Arizona and New Mexico (USDA Forest Service Southwestern Region, supplement to FSH 462.1989-676-727).*

The Kachina Project area occupies a small portion of the south edge of the San Francisco plateau, which is part of the Colorado plateau dominated by the San Francisco Mountain. Steep canyons in the south portion dissect the gentle terrain. These canyons become shallow in the northern areas. The canyons are often rimmed with columnar basalt cliffs that are atop sandstone cliffs in the deepest canyon sections. The seasonally flowing streams in the canyon bottoms create cascades and pools during their flow seasons, with remnant pools persisting well into the drier seasons. In places, the bedrock has been sculpted by water leaving interesting and unique rock forms in the stream channel.

The canyon vegetation generally contrasts with vegetation on top of the plateau, reflecting the contrast between canyon and plateau microclimates. Within the canyon walls, the vegetation is often highly varied and distinct, with deciduous trees such as aspen, oak, alder, and maple interspersed with conifers such as Douglas-fir and pinyon pine that create diverse vegetation patterns that change seasonally.

The ponderosa pine forest on the plateau above the canyons contains small remnants of the historic forest condition described in early accounts of the area. Historic accounts and photos describe a relatively open landscape dominated by large "yellow barked" ponderosa pine trees in huge grassy "parks" and also patches of pine and oak in a grassland matrix. A profusion of grasses and herbaceous vegetation covered most of the ground and very little brushy vegetation existed. Small grassy or boulder-strewn openings were interspersed throughout the more heavily forested areas.

Ecologists believe that the extensive pine forest of the Colorado plateau has only existed since the time of the last ice age, approximately 10,000 years ago. Before 10,000 years ago it is believed that spruce trees dominated the forest of the plateau. It is likely that the landscape character of the area changed little prior to European settlement. European settlement brought with it landscape management practices, such as intensive grazing, logging, and fire suppression, that have resulted in the present forest scenic condition.

Most forest stands throughout the Colorado plateau changed dramatically in appearance over a period that started around 1880 and continues today. The open pine parks, dominated by large, yellow-barked ponderosa pine, have given way in most places to more dense stands of smaller, black barked ponderosa pine trees such as those predominant in the Kachina analysis area. The present Colorado plateau forest stand typically has many more trees and more forest litter, such as pine needles, limbs, pine cones, and logs, and much less grass and herbaceous ground cover; and appears much more dense and shaded, than the pre-European forest.

The rapid change in landscape character over the past century contrasts snapshots of two very different characteristic landscapes, one that evolved for thousands of years and one that has come into dominance within the past century and a half. The contrast in the appearance between the two represents a range of variability in both ecological processes and in the resultant scenic values. Recent years have shown the visible result of larger and more numerous forest fires on forest landscapes, compelling us to consider large burned over areas as also within the "natural" range of variability for forest landscapes.

The denser tree cover that presently exists limits visibility, while the forest floor is often covered in several inches of forest litter that tends to exclude herbaceous vegetation and grasses. The profusion of small pine trees limits the viability and life span of the remaining large trees, both pine and oak, as described elsewhere in this EIS. The crowding reduces the growth rate of trees throughout entire stands so that the rate at which trees become larger and more valuable scenic elements slows at the

same time that crowding reduces the number of remnant large trees. The prevalence of small trees obscures the presence and dominance of the large trees, diminishing their large scale and muting the intensity of their bark and foliage color. The resulting scenic character is more limited in scope, often confined to only a few contiguous acres or less, with relatively little variety of plant life visible on the forest floor. The result is that the scenic value of the Kachina area landscape is diminishing as the dominance of smaller trees progresses and the vegetative pattern becomes visibly less diverse.

Research suggests that most people prefer the appearance of a more open forest with less forest litter and more ground cover plants visible. Most people also prefer the presence of larger trees in general and of large "yellow bark" ponderosa pine in particular.

Scenic integrity is a measure of the degree to which a landscape is visually perceived to be "complete." Scenic integrity analysis is used primarily to address the direct effects of activities on the landscape. Activities affecting scenic integrity for the Kachina Project include visible evidence of proposed thinning activities such as slash, skid trails, and stumps, as well as evidence of recreational activities such as fire rings, off road trails, site compaction, and litter.

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