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Burnt Corral Vegetation Management Project

Preliminary Environmental Assessment

Forest Service Kaibab National Forest North Kaibab Ranger District March 2020

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Cover Photo Description: Ponderosa Pine in the Burnt Corral Project Area. (US Forest Service Photo).

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Contents

List of Tables

List of Figures

Introduction

The USDA Forest Service proposes to thin ponderosa pine and other vegetative stands (utilize commercial thinning and/or prescribed fire treatments) on approximately 28,090 acres, on the North Kaibab Ranger District of the Kaibab National Forest. The Burnt Corral Vegetation Management Project (Burnt Corral) calls for the implementation of proposed activities in an effort to restore forest health, beneficial fires regimes, and wildlife habitat in the ponderosa pine belt on the west side of the Kaibab Plateau.

Inspiration for the project stems from the 2009 Kaibab Forest Health Focus (Sisk et al. 2009[1]), a collaborative landscape assessment that identified priority management areas, and from the Kaibab National Forest Land and Resources Management Plan herein after referred to as the "forest plan" (USDA FS, 2014[2]). The overarching goal of this effort is to improve forest health and vigor, while creating habitat conditions that are more resilient to change in the event of wildfire and/or other climatic condition changes. In working toward this goal, the Burnt Corral planning phase (July 2014 through May 2015) involved a collaborative work effort between stakeholders, in which a consensus on recommendations and approaches for the proposed action were developed to help sustain ponderosa pine as a renewable resource. Overall, the project and its proposed action would help guide management for on-the-ground restoration actions.

This Environmental Analysis was prepared to determine whether implementation of the proposed treatments may significantly affect the quality of the human environment, which would require the preparation of an environmental impact statement. By preparing this environmental assessment, the Forest Service fulfills agency policy and direction to comply with the National Environmental Policy Act of 1969 (NEPA); the Forest Service procedures for implementing NEPA are codified in 36 CFR part 220.

Project Location

Burnt Corral is located approximately 38 miles south-southeast of the town of Fredonia, Arizona, and is situated predominately west of Forest Service Road 22. (See figure 1). The 28,090 acre project area lies within the southwest portion of the Kaibab Plateau, south-southwest of Lookout Canyon on the North Kaibab Ranger District of the Kaibab National Forest. A general legal description is as follows: Townships 35 to 37 North; Ranges 1 West to 1 East, Gila & Salt River Baseline and Meridian (Coconino County, Arizona).

The majority of the ponderosa pine vegetation type in the project area is located west of Forest Service Road 22. Forest Service Road 447 bounds the project area to the north, Forest Service Road 226 to the east, Forest Service Road 203/203A and the Forest Service Road 425 to the south, and Forest Service Road 425 and 427 to the west.

[1] http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5120031.pdf
[2] https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd517406.pdf

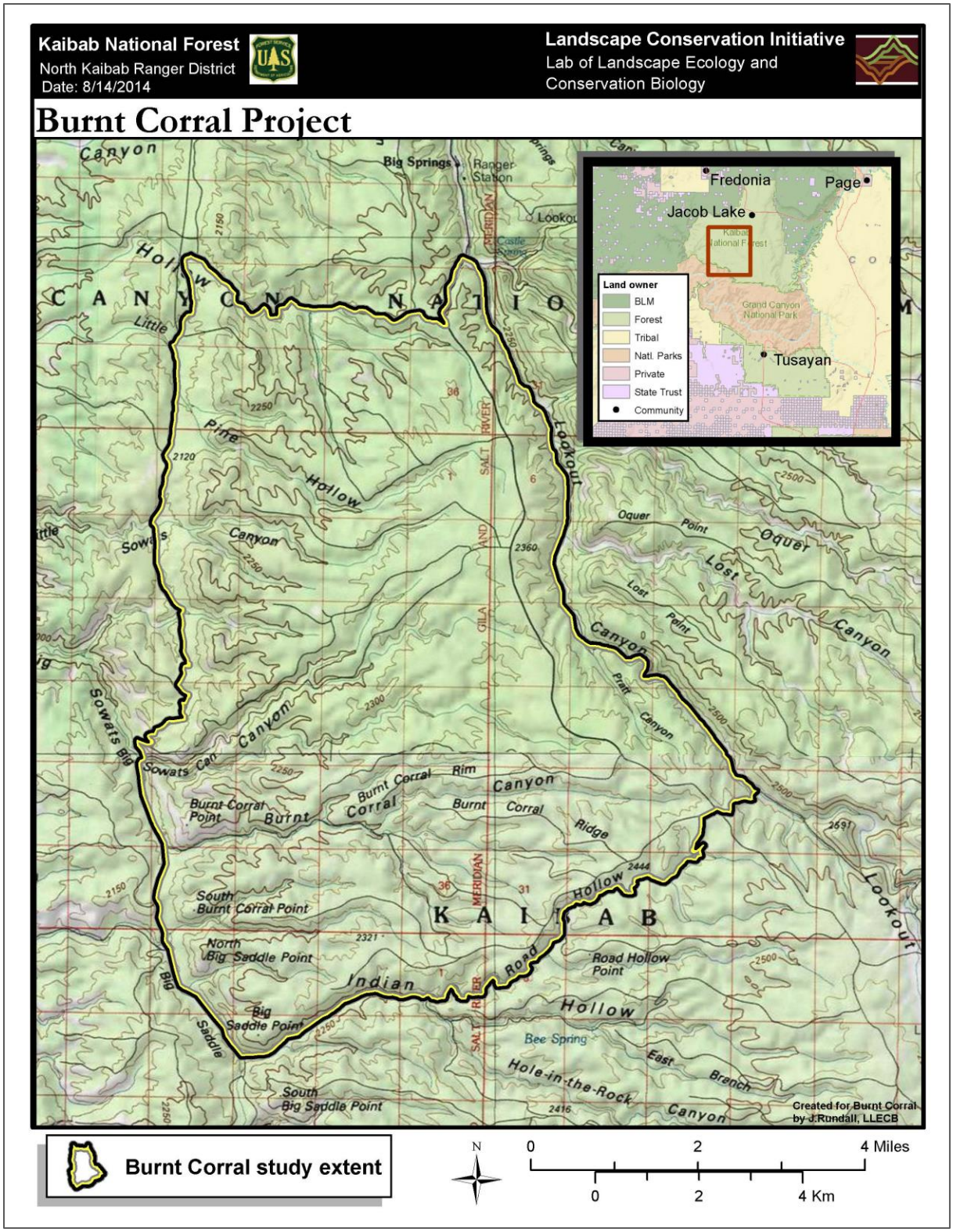

Figure 1. Burnt Corral Vegetation Management Project Location Map

Background Information

The majority of the project area falls within a "Priority Landscape[2]" identified by the Kaibab Forest Health Focus (Sisk et al, 2009), encompassing the western ponderosa pine belt of the Kaibab Plateau. This led the forest to select this area as the first phase of the larger, landscape-level restoration approach (similar to treatment as proposed in the Kaibab Plateau Ecological Restoration Project[3]) based on a collaborative, science-based assessment of forest composition and predicted fire behavior data. The western edge of the Burnt Corral project corresponds to the ecotone between ponderosa pine forest and the pinyon-juniper and oak woodland area, with approximately 7,520 acres in the west-northwest portion overlapping into the 1996 Bridger Knoll Fire area. Oak patches dominate the Bridger Knoll Fire area, with New Mexico locust and open areas supporting bunch grasses and other low-lying vegetation. Some salvage activity along with some ponderosa pine reforestation (about 1,550 acres) has been completed since the 1996 fire. The Mill Fire (2008) area (1,710 acres of which 1,400 acres overlaps Burnt Corral) also lies within the northeast corner of the Burnt Corral planning area.

The project area also lies within the Grand Canyon National Game Preserve, the Kaibab Squirrel National Natural Landmark, and Arizona Game and Fish Game Management Unit 12A west. The lower elevations of the project area on the west side of the Kaibab Plateau are a key asset to the North Kaibab Ranger District due to heritage/cultural, range, recreation and wildlife resource values. There are less than 400 acres of Mexican Spotted Owl Recovery Habitat in the southeast corner of the project area. The project area is currently open to firewood gathering by permit.

In September 2009, the Kaibab Forest Health Focus (Sisk et al. 2009) recommended vegetation management treatments designed to reduce fuels and increase canopy spacing, thereby lessening the risk of losing ecosystem components due to uncharacteristic wildfire. The collaborative group viewed this ponderosa pine portion of the district as a single priority area divided into four priority treatment areas (figure 2), each of which would receive a configuration of treatments that most efficiently meet ecological restoration goals, including the return of natural fire regimes. In addition, the group expressed an interest in moving towards a forest structure in the pine type that favors the groups or clumps of multi-storied, uneven aged stands. The group recognized that the western ponderosa pine belt of the Kaibab Plateau represents a significant management challenge and that conditions are sufficiently variable to demand more detailed guidance when performing project-level planning, as the 2009 Kaibab Forest Health Focus was more landscape oriented.

[2] Priority Landscapes are areas prioritized for ecological restoration treatments for the purposes of reducing fire hazard to communities, protecting and improving wildlife habitat, and restoring forest health. (KFHF 2009, p. 2)
[3] https://www.fs.usda.gov/project/?project=54226

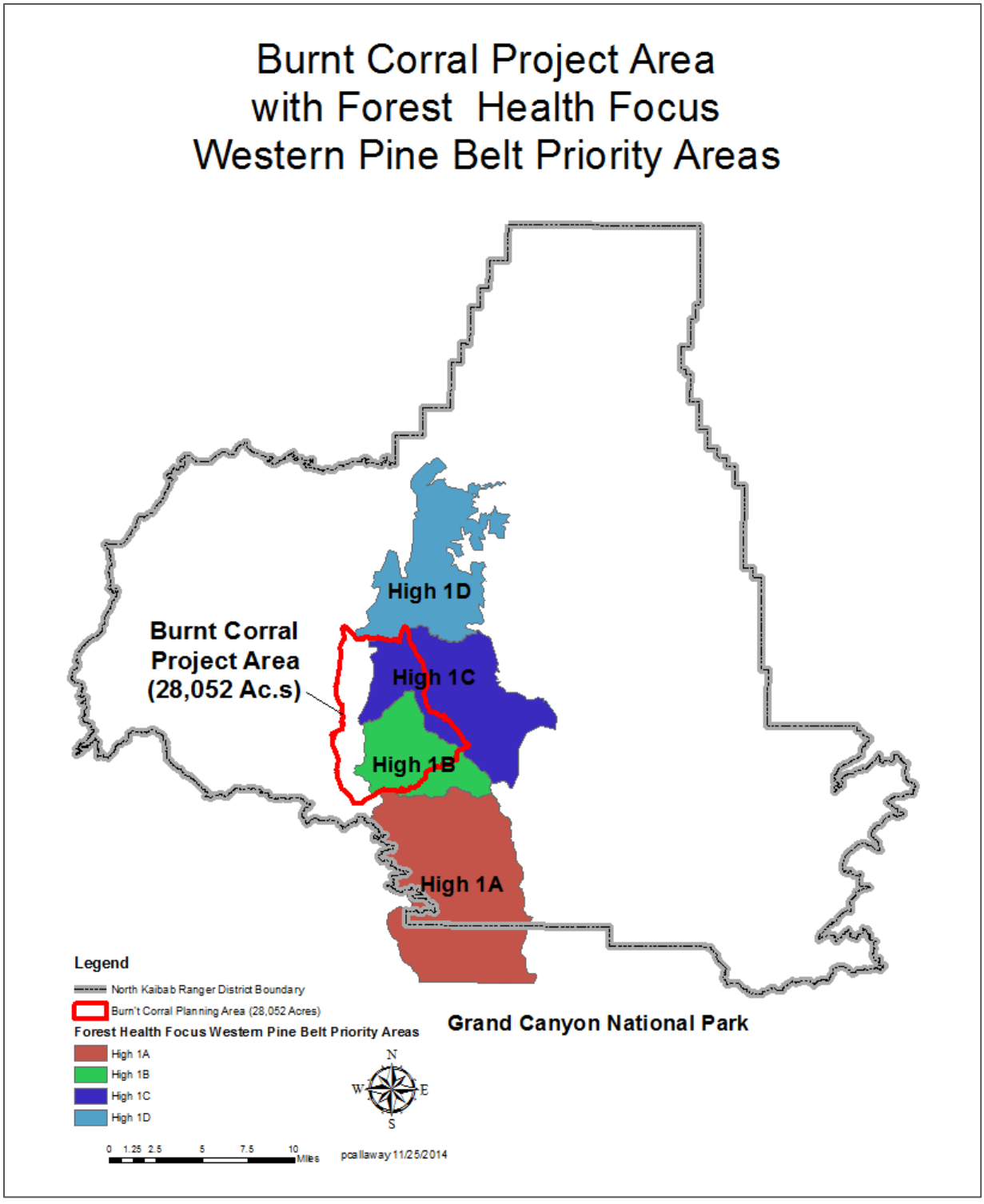

Figure 2. Burnt Corral project area[4] within ponderosa pine belt priority areas as defined by the 2009 Kaibab Forest Health Focus.

[4] note: The western boundary of the project extends beyond the priority areas in order to utilize an existing road to facilitate logistics and planned fire management activities.

Burnt Corral was conceptualized in May of 2011, as part of the North Kaibab Ranger District 5-year Vegetation Management Plan (USDA, 2011) a tool used for future resource planning and allocation purposes. The area was selected because it was identified as a priority, and modest adjustments to boundaries and location were made in order to conform to district priorities, and related, recently completed, and ongoing projects.

Within the project area, the ponderosa pine forest vegetation community occurs at elevations ranging from 6,800 to 7,800 feet. Topography ranges from the flatter, higher elevation areas on the Kaibab Plateau, to the lower-elevation bench areas on the western side. There are also numerous canyons and ridgelines, most of which run in an east-to-west direction. Steep sloped areas (greater than 40 percent) and sensitive soils are present along most of the ephemeral drainages in the western half of the project area. A large component (approximately 75 percent or 21,200 acres) of the forest within Burnt Corral is ponderosa pine (figure 3).

The ponderosa pine vegetation type, or pine component, is generally denser and more continuous across all developing stages (three different ages and size classes at a minimum) than the structural characteristics of the forest in a state of reference condition. Reference conditions are environmental conditions that indicate ecological sustainability. When available, reference conditions are represented by the characteristic range of variation (not the total range of variation) prior to European settlement and under the current climatic period. For many ecosystems, the range of variation also reflects human-caused disturbance and effects prior to settlement. It may also be necessary to refine reference conditions according to contemporary factors (such as impacts caused by invasive species) or projected conditions (including climate change). Reference conditions are most useful as an indicator of sustainability when they have been quantified by amount, condition, spatial distribution, and temporal variation.

Forest Plan Consistency

The forest plan (USDA FS 2014) places emphasis on restoring the ponderosa pine component of the forest, which has significantly departed from desired conditions and, constitutes a priority need for change (see Forest Plan, pp. 16-20, 30-32, & 191-192). Projects in ponderosa pine should be aimed at restoring forest structure, as well as processes such as low-intensity fire, natural levels of disturbance, and nutrient cycling. Design features may increase diversity within treatment areas by promoting aspen and oak (see Forest Plan, “Aspen” – pp. 27-29; “Oak” – pp. 39-40), and openings and understory production. While treatments strive to mimic the structure and patterns of reference conditions, they can also reflect other desired conditions and objectives. As a result, reconstructed reference conditions are general guides rather than rigid restoration prescriptions. (See Appendix B “Relevant selections from the Kaibab National Forest Plan”). The forest plan briefly discusses the existing and desired conditions of the ponderosa pine forest as follows:

> “Ponderosa pine forests on the Kaibab National Forest are generally denser and more continuous across all developmental states than in reference conditions. The open, park-like stands characteristic of the reference conditions for ponderosa pine forests promoted greater floral and faunal diversity and fire resilience than the dense stands of today. Accumulations of forest litter and woody debris are much higher than would have occurred under the historical disturbance regime. Lack of fire disturbance has led to increased tree density and fuel loads that heighten the risk of uncharacteristically intense wildfire and drought-related mortality. When fires occur under current (2014) conditions, they tend to kill a lot of trees, including the large and old trees. These trees take longer to replace, moving the Kaibab National Forest further from desired conditions, and increasing the time it would take to return to desired conditions. There is currently a moderate risk of insect and/or disease outbreak, which is also a function of increased tree density.” (USDA, 2014, pg. 16)

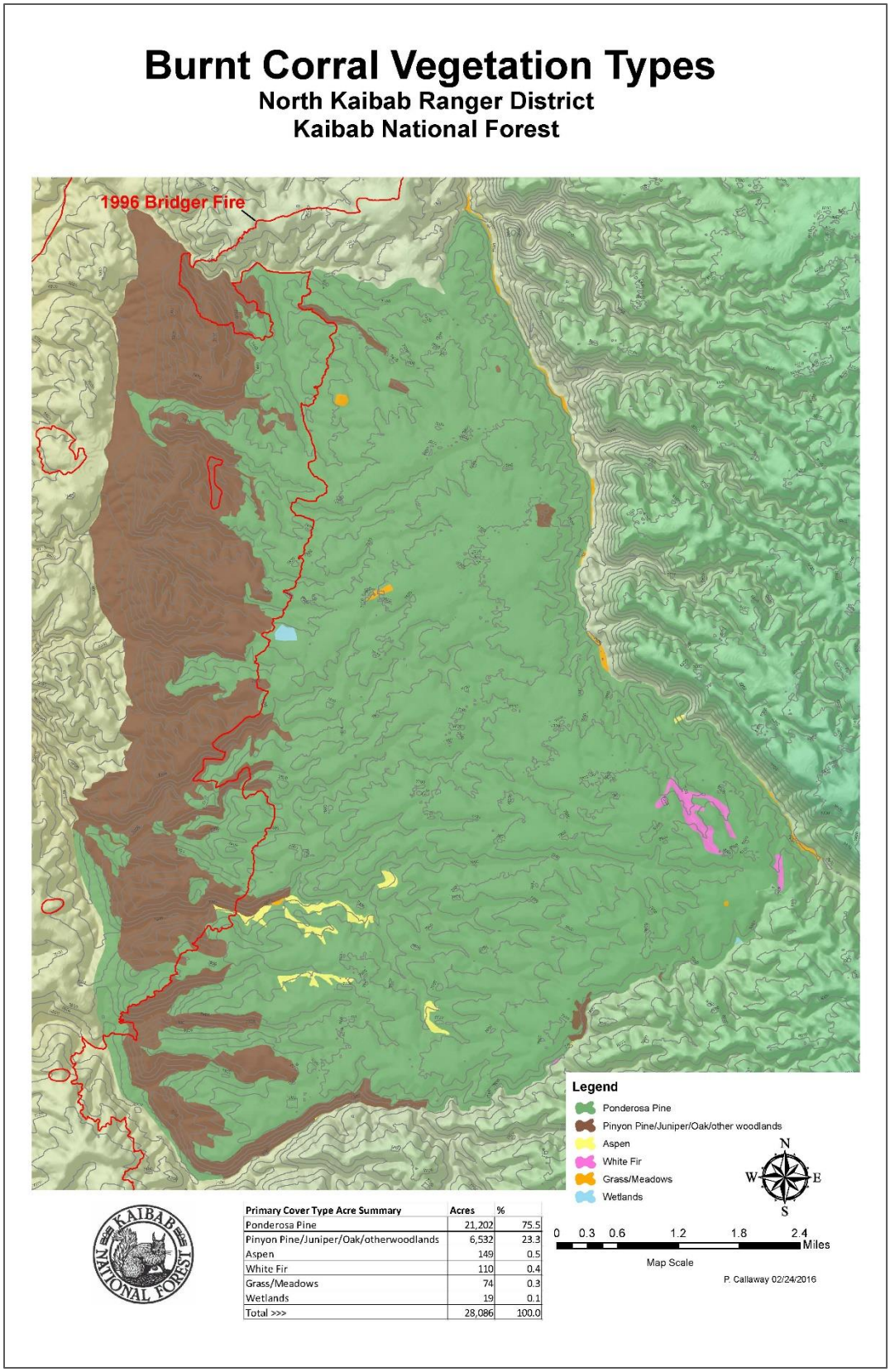

Figure 3. Vegetation types across the project area

In ponderosa pine, reintroduction of fire as the primary disturbance agent is critical to restoration. Due to capacity and efficiency needs, mechanical thinning and burning treatments are often needed to effectively progress toward the desired conditions, including the return of historical fire regimes, and assure that those conditions can be retained for at least 20 years. Tools for creating desired stand conditions and openings include a variety of treatments and uneven-aged cutting methods, such as single tree and group selection, limited even-aged regeneration cutting, thinning, and managed fire (wildfires managed for both protection and resource management objectives). Besides presenting the desired conditions at various scales (fine, medium, and landscape), the forest plan (pp. 19-20) presents a "Management Approach" for the ponderosa pine component. Listed below is part of the rationale for treatment within the Burnt Corral planning area, which is an area that is at moderate risk and scheduled for treatment now instead of the future.

Restoration activities are prioritized in areas of high risk and high value as identified by the Kaibab Forest Health Focus (Sisk et al. 2009: pp. 17-25). Primary indicators related to high risk and high value are those with closed canopies containing large trees. These areas were identified as high priority for restoration because they already contain many components of the desired condition and a single treatment may come close to meeting the desired condition, but if lost, would take centuries to replace (see figure 2).

During the development of the Proposed Action and the review of public comments from the scoping period, a forest plan consistency check was performed to ensure that Proposed Action activities were in line with objectives and standards of the forest plan. This consistency check resulted in the development and inclusion of appendix B relevant selections from the Kaibab National Forest Plan and additions to appendix A design features.

The forest plan has desired conditions (goals) organized first by vegetation cover type and then by resource area. There are many conditions desired by the forest plan. Projects, such as the Burnt Corral, which move the forest towards the desired condition, will not address every one of these desires. Prior to scoping, the interdisciplinary team reviewed the desired conditions to highlight those most applicable to Burnt Corral. After receiving comments during scoping, the district silviculturist prepared forest plan checklists for the interdisciplinary team and District Ranger to review on August 31, 2015. The meeting included a discussion on how the Proposed Action was consistent with the forest plan, which included detailed information on the following:

- Opportunities to move current condition towards desired condition
- Proposed activities that meet forest plan objectives.
- Review of Burnt Corral for compliance with applicable forest plan standards and guidelines
- Evaluation of management and designated areas
- Forest plan applicability checklists

Under the National Forest Management Act mechanical harvesting is restricted to lands found "suitable" for timber production. In developing the current forest plan, the forest conducted a suitability analysis in compliance with the National Forest Management Act implementing regulation found at 36 CFR 219 *et seq*. The analysis resulted in a determination that more than 380,000 acres of Kaibab National Forest lands are suitable for timber production. Burnt Corral is proposed on lands uniformly fit within that determination. The only exceptions are lands removed from the suitable base due to steep slopes and/or high hazard soils, or areas previously impacted by stand replacing fire (such as the Bridger Knoll fire area). It has amply been demonstrated in both the Proposed Action of the scoping notice and in this analysis, those areas have been excluded from mechanical harvesting for Burnt Corral.

Existing Condition

Dense patches of young ponderosa pine trees in even-aged condition make up the current conditions for the majority of blackjack stands within the project area (see figure 4). Many of these are in unhealthy condition due to the absence of natural ground fires when the stands were younger, and the absence of timely mechanical tree thinning or other active forest management practices over past decades.

Figure 4. Dense stands of ponderosa pine in need of thinning

These stands support more than four times the number of trees identified in desired conditions, and some show signs of competition-induced mortality (stand density index [5] greater than 57 percent of the maximum) and have high susceptibility to disease. Often, the forest floor is a thick layer of pine needles and duff with very little forage growth and no regeneration of ponderosa pine seedlings. Tree growth is suppressed, and vigor is low; these trees are susceptible to attack from *Dendroctonus* bark beetles, especially Mountain Pine beetle (*Dendroctonus ponderosae*) and the Western Pine beetle (*D. brevicomis*). Given these conditions, desirable ground fire could quickly move into the tree crowns and run through the stand, causing higher than desired tree mortality. Figure 5 illustrates a small pocket of pine beetle infestation and mortality within Burnt Corral. Current populations of this bark beetle are endemic; conditions exist for an increase in activity and potential mortality.

[5] Stand density index (SDI) is a relative measure that converts a stand's current density into a density at a reference size (Forest Plan, p. 167).

Figure 5. Group of large ponderosa pine trees killed by the western pine beetle

Desired Condition

The ponderosa pine forest vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. The forest is generally uneven-aged and open. Groups of old trees are mixed with groups of younger trees. Occasional areas of even-aged structure are present. Denser tree conditions exist in some locations, such as north-facing slopes, canyons, and drainage bottoms. Desirable ponderosa pine stands include a mix of age and tree sizes, openings available for forage and grass production, space between groups that break up the continuity of the canopy, fire resistance[6], and a young forest component to help ensure sustainability.

[6] The ability of a ponderosa pine tree or stand to withstand natural or prescribed fire conditions, that maintain or move the forest towards a more desirable condition of being a fire-adapted ecosystem.

Purpose and Need for the Proposal

Consultation with diverse stakeholders and quantitative exploration of existing data allowed consideration of multiple values and perceived risks associated with the Burnt Corral Project, and the Kaibab Forest Health Focus. During this stakeholder process, the district integrated the broad experience, expertise and ideas of stakeholders into a proposed action that would achieve project objectives at multiple scales, consistent with the results from the Kaibab Forest Health Focus and the requirements of the forest plan.

The overall purpose of Burnt Corral is to: improve ecosystem resilience and function at the landscape scale to sustain healthy forests and watersheds for future generations; and maintain and promote a ponderosa pine/frequent fire forest vegetation community that has a mosaic of forest conditions composed of structural stages ranging from young to old trees.

Based on collaborative efforts and internal Forest Service review, this project would move the project area toward desired conditions defined in the forest plan and be consistent with prioritized areas, as identified by the Kaibab Forest Health Focus (Sisk et al, 2009). The project focuses on improving forest health and vigor, while enhancing habitat conditions to make them more resilient to change in the event of wildfire and other changes in climate or related stressors (drought, large bark beetle infestations). To achieve this, there is a need to:

- Return ponderosa pine forest to a fire adapted ecosystem (high frequency – low intensity surface fires);
- Manage fire in first entry and follow-up prescribed fire treatments (maintenance burns for secondary treatment);
- Retain large and old ponderosa pine trees while reducing heavy fuel loads and overly dense stands of smaller trees present in many portions of the project area;
- Restore forest structure and process (including natural disturbances such as low-severity fire, watershed function, and nutrient cycling) by restoring the ponderosa pine forest type to increase resilience to disturbance, improve forest health, and improve habitat. To achieve this, the project would:
    - Thin at the mid-scale (100 to 1,000-acre segments) to a desired basal area of 60 to 80 square feet per acre, with larger trees (greater than 18 inches in diameter) contributing the greatest percent of the total basal area. Some areas such as goshawk post-fledging family areas, Mexican spotted owl nesting/roosting habitat, drainages, and steep north-facing slopes would contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in the general forest;
    - Reduce ladder fuels and increase tree crown base heights;
    - Reduce tree density and stand density index to the lower range of site occupancy, about 35 – 40 percent of max stand density index in ponderosa pine;
    - Stimulate oak regeneration;
    - Stimulate aspen regeneration in the project area especially where it currently exists and at the head of draws, ephemeral streams, and hollows;
    - Retain the remainder of surviving pine trees in the 7,520 acres, that overlaps the burned area left in place as a resulted of the 1996 Bridger Knoll fire;

- Protect existing ponderosa pine plantations established by past reforestation tree planting efforts following the 1996 Bridger Knoll Fire salvage timber sales;
- Reduce the risk of hazardous, stand-replacing crown fire events in the entire project area, especially portions of the project area that have received no timber treatments nor experienced fire events in the last 25 years;
- And, promote uneven-aged forest where lacking, maintain current uneven-aged forest, and create openings in even-aged older stands by creating new patch cuts from one-half to four acres distributed randomly across the landscape.

- Maintain and promote a ponderosa pine/frequent fire forest vegetation community that is a mosaic of forest conditions composed of structural stages ranging from young to old trees. To achieve this, the project would:
  - Balance age/size classes (3 classes minimum) to achieve an un-even aged structure;
  - Reduce basal area stocking by thinning the matrix[7] through the size classes that are in excess, to promote or increase forest health and vigor;
  - Establish clumps and groups in a fashion that forms more of a mosaic at the fine and midscale;
  - Increase production of forage;
  - Create more openings;
  - Create gaps in the canopy so natural surface fire would tend to remain on the forest floor; and
  - Enhance tree vigor and growth conditions to produce large, thick-barked fire-resistant ponderosa pine trees.
- Improve forest habitat for wildlife species. To achieve this, the project would:
  - Improve ecosystem resilience in goshawk nest areas with thin from below and ladder fuel reduction treatments;
  - Create healthier wildlife habitat diversified and capable of supporting a variety of animal species.
  - Manage for or retain habitat elements required by the Mexican Spotted Owl Recovery Plan (2012) for 358 acres of Recovery Habitat. These elements include hardwoods, large snags (greater than 18 inches diameter at breast height), large downed logs (greater than 18 inches diameter at any point), and large trees (greater than 18 inches).

The Proposed Action scoped in March 2015 was more detailed than the updated version presented in this Environmental Analysis. The interdisciplinary team synthesized the purpose and need for action in section II of the scoped proposed action to display a more focused purpose and need and to ensure the project meets the intent of the forest plan. The more detailed version of the "Purpose and Need for Action," is available at the Burnt Corral project website: https://www.fs.usda.gov/project/?project=44236 The Proposed Action scoped in March of 2015 provided a detailed listing of consideration of secondary or related activities and benefits that relate to the purpose and need. Many items within the scoped Proposed

[7] The matrix is the area (i.e., acres) between groups of trees designated for commercial timber harvest.

Action are now shown as design features. Below is a brief summary of various connected activities and/or benefits that may result from implementation of the Proposed Action:

- Maintain or improve the motorized public transportation system (roads leading to and from the project area);
- Manage recreation uses with an emphasis on maintaining scenic integrity, while providing for visitor safety;
- Reduce risk to fire sensitive cultural sites and sustain existing archaeological sites, traditional cultural properties, sacred sites, and forest resources associated with traditional practices;
- Offset treatment costs and benefit local rural economies; and
- Identify baseline carbon stocks and consider this information in management in accordance with the 2012 Planning Rule and the Forest Service's Climate Change Performance Scorecard.

Public Involvement

Collaboration and Scoping

Collaborative efforts are ongoing and include partnerships with other government agencies and special interest groups. In development and preparation of Burnt Corral, the North Kaibab Ranger District encouraged participation of stakeholders such as interested persons, state and local governments, and Indian tribes so they may be involved throughout the planning process. The Kaibab National Forest conducted Tribal consultation, as directed by 36 CFR 800 and the Programmatic Agreement, and sent individual Tribal scoping letters to the various Tribal agencies on June 27, 2014.

Building on the spirit and outcomes of the Kaibab Forest Health Focus, collaboration for the Burnt Corral Project started in mid-2014 with the Kaibab National Forest and the Landscape Conservation Initiative (at Northern Arizona University as a collaborative project-level planning effort to develop a Proposed Action to guide the scoping phase of the project and to inform the NEPA analysis. The purpose of the collaborative was to address key issues prior to the actual scoping phase of the project's Proposed Action. The purpose and need, as well as the Proposed Action, were derived from a basic outline that was reviewed and refined by the collaborative, and represents a Proposed Action developed through considerable deliberation, vetting, debate, and compromise.

Planning and notification of the project was first posted on the forest's third quarter Schedule of Proposed Actions (SOPA) on April 1, 2014. From June 2014 through January 2015, the Forest Service in coordination with the Landscape Conservation Initiative at Northern Arizona University, conducted pre-NEPA collaboration and planning in accordance with the National Forest Management Act with various interested stakeholders, to develop a Proposed Action scoped with the public.

The Landscape Conservation Initiative at Northern Arizona University organized the stakeholder workshops what included participants from environmental groups, forest industry representatives, hunting groups, recreational groups, local tribes, community organizations, local and county government, and state and federal wildlife and land management agencies. Email and hard copy letters invited over 130 participants, and stakeholders who responded identified any additional participants for further outreach. In addition to the two workshops, a supplemental working session convened to focus specifically on the

issue of large and old trees, at the request of stakeholders. The meetings and workshops occurred on the following dates and at the following locations:

- July 23rd-24th, 2014 NAU/NKRD kick off meeting and field visit (Fredonia, AZ/North Kaibab Ranger District)
- September 18th, 2014 Stakeholder introductory meeting and field visit (Big Springs, North Kaibab Ranger District)
- October 22nd-23rd, 2014 Stakeholder meeting (Kanab, UT)
- November 19th, 2014 Working session on large and old trees (Video teleconference between Flagstaff, AZ and Fredonia, AZ)

The meetings were advertised to the public via the forest service website. About 32 individuals representing 14 organizations, including Arizona Game and Fish Department, Center for Biological Diversity, Sierra Club, US Fish and Wildlife Service, Arizona Mule Deer Foundation, and USA Conservation, participated. Many of the organizations or individuals also participated in the Kaibab Forest Health Focus or other forest planning processes.

The 30-day scoping and comment period for Burnt Corral began on March 9, 2015; however due to an error in the website address of a Forest Service link, the 30-day scoping and comment period clock restarted on March 18, 2015. The North Kaibab Ranger District provided information concerning this project directly to approximately 124 stakeholders, including private landowners, cabin owners, agencies, organizations, businesses, interest groups, and Tribes. Eleven comment letters or e-mails were received from agencies, organizations, and individuals (note: there were 528 form letters submitted from 264 individuals associated with the Sierra Club).

Forest Service personnel contacted or consulted the following individuals or entities, Federal, State, Tribal, and local agencies during the development of this environmental assessment:

- Bureau of Land Management
- U.S. Fish and Wildlife Service
- Grand Canyon National Park
- Natural Resources Conservation Service
- Local Native American Tribes
- Coconino County, Arizona; and Kane and Garfield Counties in Utah
- Northern Arizona University
- State of Arizona (including the State Historic Preservation Office)
- Arizona Department of Transportation
- Arizona Department of Environmental Quality
- Arizona Game and Fish Department
- The Center for Biological Diversity (CBD)
- Sierra Club

Issues

Issues (cause-effect relationships) serve to highlight effects or unintended consequences that may occur from the Proposed Action and alternatives, providing opportunities during the analysis to explore alternative ways to meet the purpose and need for the proposal while reducing adverse effects" (Forest Service Handbook 1909.15, chapter 12.42). Issues are site-specific cause-effect statements derived from public comments.

Prior to the first stakeholder meeting and field visit, stakeholders were asked to identify key issues and concerns that they felt needed to be addressed for progress to be made, and to share their expectations, and their perspectives on what would constitute success of the project, through surveys and interviews. This allowed the Landscape Conservation Initiative at Northern Arizona University to focus subsequent

meetings on key issues, to bring forward appropriate data, and to identify and represent the shared goals and expectations of the project. Through the survey and subsequent group discussions, the Forest Service identified a few key issues to work through in development of the Proposed Action, as well as several stakeholder concerns include:

- Old growth patches
- Old growth protection and large tree retention
- Sensitive soils and steep slopes
- "Remaining" ponderosa pine treatment
- Wildfire
- Wildlife
- Northern goshawk
- Mexican Spotted Owl
- Aspen and oak
- Information and analysis
- Reference conditions
- Roads
- Economics
- Purpose and need

These issues addressed the impacts of management and the preference for treatments to maintain or augment desired features while avoiding or mitigating undesirable impacts. Concerns and relevant approaches to addressing them, whether suggested by the stakeholder group, required by the Kaibab Forest Plan, or used in best management practices, were addressed with design features that are included with the Proposed Action.

The 11 comment letters received during scoping contained a mix of supportive or neutral comments, and some were opposing in nature regarding the Proposed Action. The interdisciplinary team reviewed the comments received during the scoping period to determine if any alternatives were recommended or if comments represented an issue with the Proposed Action. No site-specific issues with the Proposed Action were identified during scoping. Several commenters expressed support for the Proposed Action and emphasized that priority should be given to reducing the threat of wildfire at the landscape scale.

As to what is considered a specific written comment, it must be within the scope of the project and have a direct relationship to the Proposed Action. Comments on the project must also include supporting reasons or rational as to why the responsible official should consider them. For example, “because I think it’s a good idea,” would be considered a comment not supported by rational or science. Scoping Information is NOT relevant if it is: (1) beyond the scope of the proposed action; (2) unrelated to the decision being made; (3) already decided by law, regulation, or policy; (4) conjecture or not supported by scientific evidence; or (5) general comment or position statement.

Alternatives considered, and eliminated from detailed study

One commenter suggested an alternative to the Proposed Action that was not based on metrics from the current forest plan. The interdisciplinary team reviewed the suggested alternative, and one aspect of the proposed alternative the interdisciplinary team agreed with is that large tree retention is a key point to be analyzed in the NEPA analysis (as required under the forest plan). The interdisciplinary team also discussed additional information needs such as data gaps, proposed modifications, and a general description of the process and timeline. The alternative considered, and eliminated, may have improved or maintained wildlife habitat in the short-term, but would not be effective for the long-term for vegetation improvements to improve forest health and vigor). The Proposed Action is a landscape scale project greater than 10,000 acres, and within the project area there may be some areas that receive higher treatment regarding thinning of vegetation structure in order to achieve or move towards the mid-scale or landscape scale desired condition, in accordance with the new forest plan. The outcome was a decision from the district Ranger to evaluate two alternatives: the Proposed Action and the No Action Alternative for baseline conditions.

Proposed Action and Alternatives

As directed by Council on Environmental Quality (CEQ) regulations, an environmental assessment must include a brief discussion of alternatives (40 CFR 1508.9(b)). The National Environmental Policy Act requires that we study, develop, and describe appropriate alternatives to recommend courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources. There were no suggested alternatives and there were no issues resulting from public scoping that could not be addressed through the addition of design elements to the Proposed Action. Therefore, the Forest Service analyzed the No Action Alternative in addition to the Proposed Action. These alternatives are described in more detail below.

No Action Alternative

A No Action Alternative is included as a baseline for comparison to the Proposed Action. This alternative represents the existing and projected future condition against which other alternatives are compared. Under this alternative, no vegetation, fuels, or other proposed activities would be implemented through this project. Existing activities in the Burnt Corral Project area such as road maintenance, fire suppression, firewood cutting, post and pole cutting, Christmas tree harvesting, livestock grazing, hunting, and other recreational activities would continue.

Proposed Action Alternative

The Forest Service proposes to mechanically thin up to 17,765 acres, and use wildland fire (including managed and prescribed fire) alone or in conjunction with the proposed mechanical treatment, on 28,090 acres. A treatment strata[8] map (guided proposed treatments across the project area by vegetation and treatment types and estimated acres are provided below in table 1. Acreages are based on preliminary Geographic Information Systems analysis, and may be updated based on actual field data or change of conditions (acreages) prior to treatment. Additionally, existing activities as mentioned under the No Action Alternative may continue within the Burnt Corral footprint area. During implementation, certain activities, such as grazing or firewood gathering, may be excluded within an active burn block unit or timber harvest sale area, as they are actively treated. Implementation is estimated to take anywhere from 10 to 25 years for completion of Burnt Corral; 10 to 15 years for mechanical treatments and up to 25 years for prescribed fire treatments (including possible re-entry or maintenance treatments).

The Proposed Action is stratified based on relevant vegetation types and various proposed treatments for those specific vegetation types, as allowed or permitted by the forest plan (see figure 6 and figure 7 for Vegetation Types and Mechanical Treatments proposed, respectively). The proposed treatments include some fire-only treatments, and some treatments using both mechanical treatments and fire.

[8] Proposed Action Landscape Strata as mapped by vegetation type, habitat area, soils, and previous treatments or fire areas.

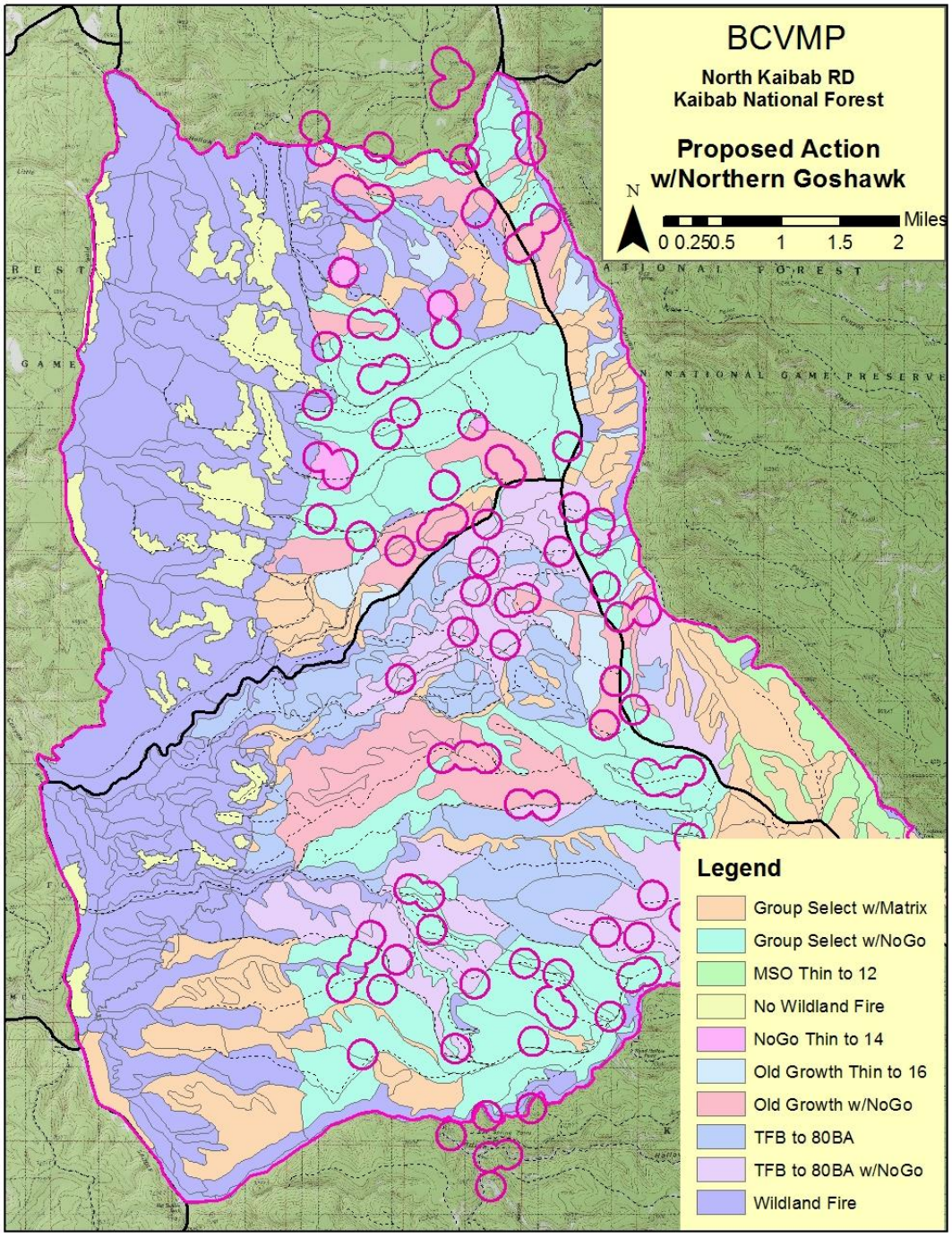

Figure 6. Vegetation type and treatments across the project area (based on forest plan)

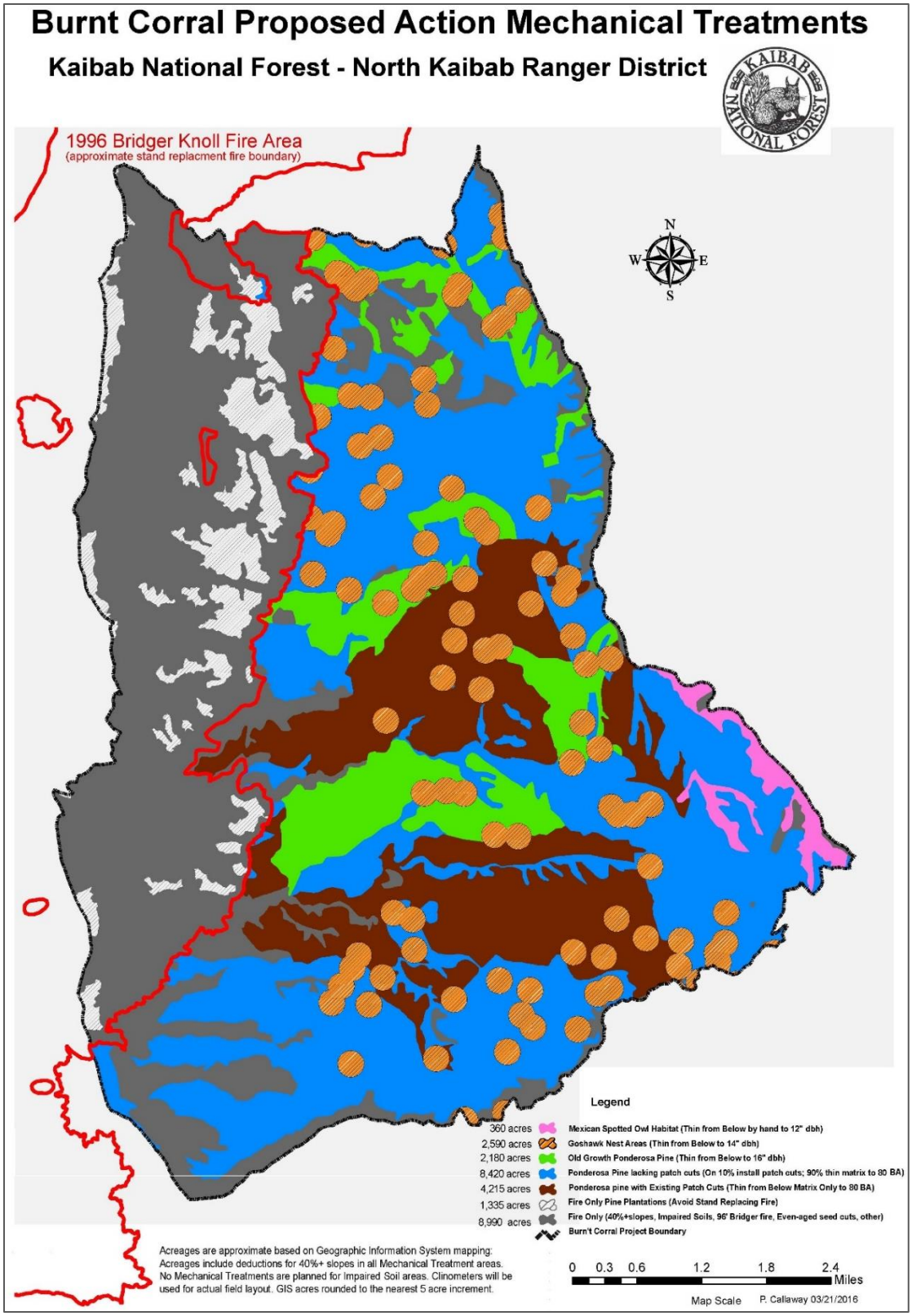

Figure 7. Landscape strata used to guide proposed treatments across the project area

The formal analysis performed under the National Environmental Policy Act followed the March 2015 scoping period. Additional detailed field surveys and more precise modeling and mapping runs may have slightly changed the acreages and adjusted some locations of proposed treatments. Based on that analysis, refined acreages are listed in table 1 for the treatment types and estimated acres of strata across the project area. The proposed treatments, including some fire-only treatments and some treatments using both mechanical treatments and fire are also listed in table 1.

Table 1. Proposed treatments and estimated acres of strata across the Burnt Corral Project Area.

Treatment Type(s) Proposed	Description of Relevant Treatment Strata[1]	Acres[2]
Wildland Fire Only[3]		
Fire Only	Bridger Knoll Fire area, sensitive soils, steep slopes, and seed cuts approaching desired conditions	8,990
Bridger Pine Plantations	Ponderosa pine plantations that were planted post Bridger Knoll Fire (i.e., within fire scar area)	1,335
	Sub-Total Acres - Wildland Fire Only	10,325
Mechanical Thinning and Wildland Fire		
Thin from below to 14 inches	Northern Goshawk nest areas[4]	2,590
Limited treatment reduces fire risk	Old growth[5] patches	2,180
Remaining Ponderosa Pine Group selection cuts and commercial thinning in the matrix between group cuts	Ponderosa Pine Lacking Patch Cuts (10% - install patch cuts; 90% - thin matrix to 80 Basal Area)	8,420
	Ponderosa Pine w/Existing Patch Cuts (w/in Matrix thin from below to 80 Basal Area)	4,215
Thin mixed conifer from below to 12 inches to reduce fire risk	Mexican Spotted Owl habitat	360
	Sub-Total Acres - Mechanical Thinning and Wildland Fire	17,765
	Total Acres Treated	**28,090**

1 Note: Treatment Strata, as mapped through GIS layers or mapping exercises.

2 Note: Acres have been rounded to the nearest 5-acre increment.

3 Note: This includes activities such as preparation thinning and other light mechanical and hand thinning treatments associated with appropriate use and management of prescribed fire and managed wildfire.

4 Nest areas (goshawk) are the areas immediately around a nest that are used by northern goshawks in relation to courtship and breeding activities. They cover approximately 30 acres and contain multiple groups of large, old trees with interlocking crowns.

5 Old growth in southwestern forested ecosystems is different from the traditional definition based on northwestern infrequent fire forests. Due to large differences among Southwest forest types and natural disturbances, old growth forests vary extensively in tree size, age classes, presence and abundance of structural elements, stability, and presence of understory (Helms 1998). Old growth refers to specific habitat components that occur in forests and woodlands—old trees, dead trees (snags), downed wood (coarse woody debris), and structure diversity (Franklin and Spies 1989, Helms 1998, Kaufmann et al. 2007). For additional information see forest plan (pp. 18, 128, 163, and Appendix C. "Large Tree Retention Classes for Ponderosa Pine."

Wildland Fire (up to 10,325 acres)

Treat up to 10,325 acres (See table 1 and figure 7) using wildland fire. Wildland fire refers to prescribed fire as well as managed wildfire, and includes activities such as preparation thinning (hand thinning and/or mechanical thinning with the use of mastication head or similar small, low ground pressure equipment) the construction of control lines, and other treatments associated with appropriate use and management of prescribed fire and managed wildfire.

Sensitive soils and steep (40 percent or greater) slope treatments (up to 2,250 acres of which 615 acres overlaps both areas) include:

- Use wildland fire to burn when needed to achieve management objectives
- Where fuel loading could result in undesirable fire effects, use preparation thinning (hand thinning or small, low-ground pressure equipment) and piling in preparation for wildland fire
- Mitigate and avoid negative impacts to sensitive areas by using best management practices and design criteria for soil protection.

Ponderosa Pine seed tree cuts in areas approaching desired conditions (up to 420 acres):

- Use wildland fire to burn when needed to achieve management objectives.

Mechanical Thinning and Fire (up to 17,400 acres)

Treat up to 17,400 acres[9] using both mechanical thinning (commercial) and wildland fire.

Ponderosa Pine forest: Northern Goshawk nest areas (up to about 2,590 acres):

- Within areas designated for Northern Goshawk, nests or replacement nest areas up to 415 acres are areas of steep slopes and sensitive soils.
- Mechanical Treatments
    - Where needed to protect and/or enhance nesting habitat, thin from below up to 14-inch diameter at breast height in goshawk nest areas
    - Manage for or retain snags, downed logs, woody debris and old trees, whenever possible
- Wildland Fire
    - Where possible, use wildland fire in preference to or in coordination with mechanical treatments
    - Wildland fire use may occur pre-or-post mechanical treatment, and multiple fire entries may occur over the project life

Ponderosa Pine forest old growth patches (up to 2,180 acres):

- This portion of the project area supports relatively dense stands of pre-European settlement trees and retains conditions consistent with pre-European settlement ponderosa pine ecosystems. Some of these areas are candidate old growth protection sites (henceforth “old growth patches”).

- Preliminary analysis based largely on previous Landscape Conservation Initiative at Northern Arizona University models and guidance provided at the Kanab meeting of the Burnt Corral Stakeholders Group, suggest that a combined area of approximately 2,180 acres would capture most continuous patches of ponderosa pine forest exhibiting old growth conditions. The intent of identifying these old growth patches is to protect areas recognized as current and future reservoirs of old growth forest composition, structure and function. These areas would be managed in conjunction with design features for retaining old and large trees, generally, to ensure the adequate representation of the composition, structure and function of old growth stands, including their living and non-living components.

[9] Not including Mexican Spotted Owl Recovery habitat

- Mechanical Treatment
  - Conduct limited mechanical treatments to thin post settlement trees less than 16-inch diameter at breast height as necessary to reduce ladder fuels
  - Retain structural diversity
  - Retain old growth components including large snags, large coarse woody debris (including downed logs), and large and old trees
- Wildland Fire
  - Use wildland fire in coordination with mechanical treatments
  - Wildland fire use may occur pre or post mechanical treatment, and multiple fire entries may occur over the life of the project
  - Establish fuel breaks along major forest roads like Forest Service Road 422, 255, and 425 to provide public safety and protection for firefighters if a high intensity, fast moving crown fire event occurred.

Ponderosa Pine Forest: Remaining Area (up to 12,635 acres)

For the remaining acres of ponderosa pine the following activities are proposed:

- Mechanical Treatments
  - Use group selection cuts varying in shape to create openings that are an irregular and heterogeneous forest mosaic, characterized by treatments from 1/2 to 4 acres in size, with a maximum width of 200 feet. The intent of these selection cuts is to manage for current and future uneven-aged conditions while reducing fuel loads and fuel continuity, without creating a homogeneous stand structure or a regular or repetitive “cookie cutter” structure of alternating dense stands and openings.
  - Create openings (utilizing “Group Selection” cuts), which range in size from ½ acre, up to 4 acres, with a maximum width of 200-feet for any opening 2 acres or greater in size. Openings would be laid out in a random mosaic pattern within treatment units. Selected seed trees would be left in openings greater than 2 acres to maintain and promote desired or healthier genetic traits.
  - Use commercial thinning in the matrix areas between groups to a target basal area to restore the ponderosa pine type and resilient forest stands able to withstand frequent wildfires.
  - Strategically place treatments and vary the sizes of thinned areas on the landscape, taking advantage of topography and roads, particularly East-West roads, to achieve fire management objectives.
  - Generally, treat more intensively on south-facing slopes and areas upwind of nest areas, old growth patches, and other areas of denser trees of particular value or vulnerability to fire.
  - Generally, forego mechanical treatment in areas where fire models predict passive surface fire.
  - Develop and/or maintain structural diversity, including some areas with interlocking crowns and wildlife hiding cover at the stand level.
  - Develop and/or maintain at least 3 age classes in roughly even proportions across 100 to 1,000 acre subunits.

- Wildland Fire
  - When possible, use wildland fire in coordination with mechanical treatments
  - Wildland fire use may occur pre- or post-mechanical treatment, and multiple fire entries may occur over the project life

Mexican Spotted Owl Habitat (up to 360 acres)

Three hundred and fifty-eight acres of the project is designated as Mexican Spotted Owl recovery habitat such as potential nesting/roosting habitat, and would be managed consistently with the recovery plan for the Mexican Spotted Owl (*Strix occidentalis lucida*), First Revision (USDI, 2012a). About one hundred eighty acres of recovery habitat overlap with steep slopes and sensitive soils. Any guidelines developed for steep slopes and sensitive soils would be used as operational guidance and would conform to the recovery plan. All treatments would move the habitat towards nesting/roosting habitat desired conditions within the recovery plan (table C.3, pg. 278).

- Mechanical Treatments
  - Thin from below up to 12-inch diameter at breast height, based on field conditions and pre-treatment stand conditions thinning may only occur up to 9-inch diameter at breast height to meet desired conditions.
  - Multiple mechanical entries may be required during the life of the project to meet desired conditions.
  - Retain Mexican Spotted Owl key habitat elements required by the recovery plan. Key habitat elements include hardwoods, large snags (greater than 18-inch diameter at breast height), large downed logs (greater than 18-inch diameter at breast height at any point), and large trees (greater than 18-inch diameter at breast height).
  - Maintain the primary constituent elements of Mexican Spotted Owl critical habitat; areas outside of recovery habitat (such as Ponderosa pine) would be treated to protect the habitat from uncharacteristic high intensity wildlife and other natural disturbances.
- Wildland Fire
  - Wildland fire would be implemented as appropriate to retain the key elements mentioned above, as well critical habitat primary constituent elements.
  - Prescribed fire may occur pre- or post-mechanical treatment. Multiple fire entries may occur over the life of the project within recovery habitat to meet desired conditions.

Activities specific to the Bridger Knoll Fire Scar (up to 7,520 acres)

Activities in the 1996 Bridger Knoll Fire Area (up to 7,520 acres) include:

- Use wildland fire and spot treatments of prescribed fire, as needed, to achieve management objectives
- Minimize seed-dispersing agents and soil disturbance activities to lessen or avoid the spread of cheat grass and other invasive plant species.
- Protect existing regenerating trees from fire and mechanical activities as appropriate to meet management objectives
- Develop burn plans in consultation with the Arizona Game and Fish Department to meet wildlife habitat objectives.

- Create interspaces within an uneven-aged forest structure to facilitate habitat (grasses, forbs, and shrubs) for goshawk prey species as well as various other wildlife including but not limited to songbirds and deer.
- Protect Northern goshawk nest areas, which should be denser than the surrounding forest with large trees being dominant, but not homogenous, and have interlocking crowns.
    - ♦ Maintain or improve the variety of vegetation types and structures to provide a range of habitats for wildlife species including but not limited to Merriam's turkey roost sites (ponderosa pine groups)
    - ♦ Gambel oak as a transition habitat for Mule deer and forage for Merriam's turkey
    - ♦ Interspersed trees ranging from 8-18 inches diameter at breast height, with some continuous areas of interlocking crowns, as quality pine habitat for Kaibab squirrel (*Sciurus aberti kaibabensis*)
    - ♦ Maintain snags around waters for bat roosts

Roads

- Maintain existing system of roads and prevent development of new roads. The existing system of open and administrative roads provides adequate access for implementation of the project. (Gravel replacement overlay, and cleaning of borrow ditches and culverts, as part of normal road maintenance activities).
- Any existing closed roads that are temporarily reopened to access treatment units would be closed and decommissioned following project completion. Some existing open roads may be temporarily closed during project implementation as a public safety measure.

Protection of Sensitive Areas

The Proposed Action would comply with forest plan standards and guidelines. Design features are incorporated into the project to protect forest resources of vegetation, soil, water, scenery values, terrestrial species habitat, and heritage resources. Mitigation measures and best management practices would be implemented during the project to limit erosion, reduce impacts to terrestrial species and habitat, to protect heritage resources, to prevent the introduction and spread of invasive plants, and to protect public health and safety. Appendix A – includes the design features that are an integral part of this project put into place to mitigate or protect sensitive areas, such as those listed below:

- Springs, seeps and draws
- Plants of cultural importance
- Sensitive soils and steep slopes; reduce active headcuts or downcuts in ephemeral drainages
- Areas of recreational interest
- Caves and Karst Features, including sinks
- Heritage/cultural sites
- Recreation opportunity and scenic objective areas
- Experimental or research study areas (i.e., such as range or silvicultural test plots).

Other Activities

The Proposed Action includes other activities:

- Encourage reestablishment of aspen in ponderosa pine-dominated stands by centering thinning efforts and group selection cuts in areas with remaining aspen trees, when feasible
- Retain existing stands of Gambel oak, including all oak greater than eight inches diameter at root collar. Encourage reestablishment in ponderosa pine-dominated stands by centering thinning efforts in areas with oak
- Work in collaboration with Arizona Game and Fish Department to evaluate natural waters and existing constructed waters and, where appropriate, improve to enhance wildlife habitat.
- Install artificial bat barks (artificial crevice to mimic a natural bark gap used by bats for roosting) near permanent and ephemeral water sources throughout the project area.

Design Features

Through collaboration, design features were identified for consideration in the project. Design features address how treatments are designed and implemented to maintain or augment desired conditions across the project area, as well as avoid or minimize possible undesirable impacts. Design features refer to consistent practices implemented across the entire project area. Of the many issues identified, the following were key items that required consideration for design features: old growth protection, large tree retention, wildlife habitat, roads, and protection of sensitive areas. The forest plan sections including guidelines for management actions and the design features and specifications, including mitigation measures and best management practices used by the North Kaibab Ranger District across projects are included in appendix A.

Environmental Impacts of the No Action and the Proposed Action Alternatives

This section incorporates by reference each resource report located in the project record (40 CFR section 1502.21). The reports contain detailed data, methodologies, analyses, conclusions, assumptions, maps, references, and technical documentation. Each resource section below summarizes potential direct, indirect, and cumulative effects of the Proposed Action, both positive and negative, and contrasts those with the effects of taking no action (Forest Service Handbook 1909.15, section 14.2).

Vegetation and Silviculture (See "Vegetation Resources Specialist Report," USDA Winter/Spring 2016)

Spatial and Temporal Context for Effects Analysis

The spatial boundaries for analyzing the direct and indirect effects to vegetation/silviculture are within a Priority Landscape identified by the Kaibab Forest Health Focus, comprising the western ponderosa pine belt of the Kaibab Plateau. The western edge of the Burnt Corral project corresponds to the transition between ponderosa pine forest and the pinyon juniper-oak woodland area, with about 7,520 acres in the west-northwest portion overlapping the 1996 Bridger Knoll Fire area. Patches of oak, New Mexico locust, and open areas supporting bunch grasses and other low-lying vegetation now dominate the Bridger Knoll Fire area. There are also ponderosa pine plantations in the Bridger Fire area in Burnt Corral.

The current plan for the project area would be to use commercial thinning, patch cuts to create canopy gaps, timber stand improvement, and burning in this entry. Eventually, there would be a need to re-enter

the area in about 25 years for site-specific management (mechanical or fire) where necessary. Given this time frame, the cumulative effects period for analysis is 25 years into the past, and 25 years into the future. The cumulative effects area encompasses the Burnt Corral project area and surrounding ponderosa pine forest on the Kaibab Plateau.

Environmental Effects

Direct and Indirect Effects - Alternative 1, No Action

Under the no action alternative current and existing management plans would continue to guide the project area. No mechanical vegetation management or prescribed burning would occur. The direct effects of the no action alternative include reduced light, moisture, and nutrients available to individual trees because of dense tree stocking; increased mortality over the entire modeling period; and stagnant ponderosa pine stands at high risk for crown fire and bark beetle attack. The no action scenario in the ponderosa pine component of the Burnt Corral project would eventually result in stands at high risk for wildfire, and susceptibility to insect and disease attack.

The No Action alternative would not protect or move the Mexican Spotted Owl habitat toward desired conditions. Though no action would result in these stands becoming dense forest with large old trees, snags and downed woody debris, the risk for hazardous crown fire would persist. The current stocking levels of basal area, trees per acre, and stand density index would not be sustainable into the future. When disturbance occurs, such as wildfire, the consequences would be loss of habitat and other important ecosystem services like watershed protection, recreational opportunities, and soil stabilization.

Cumulative Effects- Alternative 1, No Action

Cumulatively, effects of the no action alternative include continued reduction of light, moisture, and nutrients available to individual trees because of dense tree stocking; increased mortality throughout the cumulative effects boundary. Stands in the cumulative effects area would be at high risk for wildfire, and susceptibility to insect and disease attack.

Cumulatively, Mexican Spotted Owl habitat would not move toward desired conditions. Cumulatively stands would become dense forest with large old trees, snags and downed woody debris, and the risk for hazardous crown fire would persist. When disturbance occurs, such as wildfire, the cumulative effects would be the loss of habitat and other important ecosystem services like watershed protection, recreational opportunities, and soil stabilization.

Direct and Indirect Effects - Alternative 2, Proposed Action

Ponderosa Pine

The Proposed Action in Burnt Corral is a combination of treatments with seven distinct areas identified for mechanical thinning treatments. (see figure 7 and table 1).

Northern Goshawk Nest Areas

Goshawk nest areas comprise about 2,590 acres across the project area. Commercial thinning from below would be planned to remove trees less than 14-inch diameter at breast height to reduce stocking, improve forest health, remove ladder fuels, and protect habitat (see project vegetation report).

Modeling (at the time of the analysis) indicated direct effects of thinning from below to 14-inch diameter at breast height in year 2 after treatment, would be a reduction in trees per acre, and basal area. With fewer trees competing for available light, moisture, and nutrients, the residual trees would increase in growth and vigor with mortality decreased from 11 cubic feet per year to 7 cubic feet.

Overall, modeling shows that stand basal area drops from 148 to 118 and that stand density index by year four after treatment is within full site occupancy range at 192, or 38 percent of the maximum. There would also be about 1,230 board feet per acre removed as saw logs. Another growth improvement would be doubling the average tree diameter from 6.4 inches to 13.1 inches. This results in greater individual tree growth, and removing inter-tree competition (see project vegetation report). These effects would be attributed to more growing space for the residual trees, and less competition for available sunlight, water, and nutrients.

The indirect effects of improved forest health, greater tree vigor, and less competition would be a fire-resilient ecosystem better equipped to ward off insects, disease, wildfire, and other calamities. The reduction in stand density index from 68 percent to 38 percent of max would be an impressive result from this light commercial harvest.

Old Growth Areas

Old growth forest structure includes accumulations of large, dead and fallen trees, and decadence in the form of broken or deformed tops, and diseases (Hamilton 1993). During the development of the Proposed Action, the Burnt Corral Collaborative decided that areas of old growth would benefit from thinning from below to 16-inch diameter at breast height. This choice departed from the previous (1986) forest plan which had a "hands-off" approach in old growth, with no heavy equipment or logging allowed. There are about 2,180 acres of old growth in Burnt Corral that would be thinned. There is an overlap of about 550 acres of old growth in goshawk nest areas that we plan to thin from below to 14 inches diameter at breast height The old growth acres in Burnt Corral consist of about 2,730 acres.

The direct effect of light commercial treatments in old growth would be a reduction in trees per acre, basal area, and stand density index. Timber volume would also result from the treatment. Old growth characteristics are sustained despite a commercial treatment. Canopy and downed woody material are in acceptable ranges with the removal of ladder fuels and the improvement in torching index. Canopy base height also compares favorably to the Forest Vegetation Simulator simulation in the nest stands.

In summary, the light harvest in ponderosa pine old growth would directly result in:

- Greatly reduced trees per acre;
- Lower basal area and stand density index;
- Increased average diameter and height;
- Saleable timber volume to offset the costs of small tree thinning;
- Maintenance of the large tree component;
- Higher wind speeds necessary to torch individual trees during wildfire;
- More snags and coarse woody debris for wildlife; and
- Compositional diversity for enhanced fire resistance and tree resilience.

The indirect effects would be improved forest health with available light, moisture, and nutrients distributed to residual larger trees. With reduced ladder fuels and higher crown base height, the old growth areas would also be more resistant to crown fire, and resilient to insect and disease attack.

Matrix Thinning Areas in the Burnt Saddle Strata

Controlled, prescribed fire in the matrix stands further promotes the desired conditions for Burnt Corral. Direct effects include reduced basal area, all species, to 91 square foot per acre and the stand density index lowered to approximately 170 in 2026. Both metrics represent improved forest health, especially density at 38 percent of max stand density index, or the lower range of site occupancy. There would remain a healthy population of trees greater than 18-inch diameter at breast height with average crown base height over 30 feet and torching index above 50 mph for the entire modeling period. Though tree mortality increases for two cycles after the burn, it drops to normal levels by 2046 at about two trees per acre. The indirect effects of thinning and burning include improved forest health, higher base heights and torching indexes for greater fire resistance, better potential for ground fire, and greater resilience to insect attack.

Stressed trees (from drought, fire, inter-tree competition, or disease) are susceptible to attack, especially by *Ips* and *Dendroctonus species*. When individual trees have enough resources (light, nutrients, moisture), vigorous individuals are more likely to fend off beetle attacks (DeGomez et al, 2008). The proposed thinning treatments would improve tree health and resistance to disturbance such as bark beetle colonization.

Matrix Thinning Areas with Group Selection Patch Cuts

The remaining matrix areas include the rest of Burnt Corral proposed for thinning to a basal area target. There are about 8,420 acres mostly located adjacent to the Lookout Canyon and Pine Hollow areas (See figure 7, blue area). These acres include about 10 percent patch cuts, ranging in size from 0.5 to 3.0 acres. These areas would have young forest on about 900 acres with planned natural regeneration. On group selection cuts over two acres, we propose to leave five seed trees per acre with desirable phenotypic and genotypic traits, especially straight boles, fine or small limbs, and disease-free.

Direct effects include stands retaining 18 trees per acre over 18-inch diameter at breast height after 20 years with both commercial harvest and controlled fire. Additional effects include increased tree health and vigor as competing trees are removed, and stand density index drops from 376 (75 percent - self-thinning) to 170 (34 percent - full site occupancy). The fire potential metrics recover with torch index increasing from 39 mph to 57 mph in year 2036. Crown base height is lifted from 13 foot to 30 foot after 20 years. Controlled burning would be safe and effective at regular intervals into the future.

There would be about 5,000 board feet per acre of log volume directly produced from tree harvest. The sale of commercial timber would provide revenues to the Forest and help offset costs of Timber Stand Improvement, prescribed burning, and managed wildfires.

The aspen component would not be mechanically cut, but the prescribed burn would cause some mortality. There would be aspen and oak sprouting and growth response to surface fire, and removal of small, excess conifer trees. Treatments to maintain forest health and fire resilience are every 20 years.

The indirect effects discussed above in the Burnt Saddle Matrix apply to these stands as well. Improved forest health would result in greater tree vigor and resistance to biotic disturbance agents. Treated stands would also have more openings, less tree density, and better resistance to stand-replacing wildfires.

The direct effects of the patch cuts would be reduced basal area from 125 square foot per acre to 39, and timber harvest, about 14,750 board feet per acre. The stand density index values improve from self-thinning to stand-initiation condition, from 61 percent to 18 percent of maximum. Though trees per acre

remain high, most are due to natural regeneration and sprouting in the oak and aspen clones. Young aspen and oak would be fire resistant as well.

The indirect effects of having available light, moisture, and nutrients with minimal competition would be healthy stands resistant to crown fire. Mortality remains low, 1–7 cubic feet per acre until year 28 after treatment, as growth doubles to 65 cubic feet per acre. When basal area and stand density index increase to self-thinning levels, a controlled surface fire is recommended 28 years after treatment to remove excess trees per acre, especially oak and aspen. Established ponderosa pine would be fire resistant by then and able to survive a prescribed ground fire.

Mexican Spotted Owl Strata

There are about 360 acres in the southeast portion of Burnt Corral that constitute Mexican Spotted Owl habitat. The Proposed Action would thin from below to 12-inch diameter at breast height. There are about 160 acres on steep slopes that would not have logging equipment, yet we can thin densely stocked stands from below to improve forest health, reduce ladder fuels, and stimulate aspen and oak sprouting. Benefits to wildlife would be greater mast and forage for prey species, and reduced risk of hazardous wildfire.

Though improved forest health is an indirect effect of thinning and burning, the increased growth eventually results in very high basal area 28 years after treatment. To avoid a major disturbance event such as wildfire, bark beetle attack or disease, another round of treatments would be recommended in 2044 to maintain quality Mexican Spotted Owl habitat and prevent substantial mortality.

Cumulative Effects- Alternative 2, Proposed Action

The current plan for the Burnt Corral area would be to do commercial thinning, patch cuts to create canopy gaps, timber stand improvement, and burning in this entry. Eventually, there would be a need to re-enter the area in about 25 years for site-specific management (mechanical or fire) where necessary. Given this time frame, the cumulative effects period for analysis is 25 years into the past, and 25 years into the future. The cumulative effects area encompasses the Burnt Corral project area and surrounding ponderosa pine forest on the Kaibab Plateau.

Planned, present and foreseeable actions include the implementation of the Plateau Facilities Fire Protection Project and Jacob-Ryan in the Jacob Lake vicinity. Both of these projects are primarily in ponderosa pine type and encompass cumulative effects related to Burnt Corral. Presently, there have been about 3,500 acres of commercial treatments in these two projects that have cumulatively reduced the risk of high-intensity stand replacing wildfires by creating gaps in the canopy, reducing live fuel loads, and decreasing ladder fuels.

There have also been about 3,700 acres of small tree thinning and hand piling in Jacob Ryan and the Plateau Facilities Fire Protection Project. These actions have reduced trees from 1 foot to 8.9-inch diameter at breast height from over 400 per acre to about 100 to 120 trees per acre. This has reduced ladder fuels, removed dog-hair thickets, opened the forest floor, and resulted in the growth of grasses, forbs, and shrubs in the understory. With more openings, the risk of hazardous and destructive crown fires is mitigated by restoring the Historical Range of Variation (prior to European settlement and under the current climatic period) when most fires in these ponderosa pine systems were cooler, surface burns with little or no crown torching.

Other actions planned and completed in the cumulative effects analysis area include prescribed burning, and managed wildfires for resource benefit. Cumulatively, these effects from these activities when added to the effects for the project would reduce ladder fuels, remove dog-hair thickets, open the forest floor,

and result in the growth of grasses, forbs, and shrubs in the understory. When added to effects from other projects improved forest health would result in greater tree vigor and resistance to disturbance agents. Cumulatively, treated stands would also have more openings, less tree density, and better resistance to stand-replacing wildfires.

Fire and Fuels (See "Fire and Fuels Report," USDA Sept. 2017b)

Spatial and Temporal Context for Effects Analysis

Vegetation treatments, past timber sale activity, and large wildfires on the Kaibab Plateau have contributed to the current condition and would contribute to shape the future stand conditions for the area that is the spatial area for the Burnt Corral analysis. Over the past 20 years, management surrounding the project area has included wildfire suppression, prescribed burning, pile burning, mechanical thinning and various timber harvests as well as grazing and wildlife focused projects. Twenty years is the temporal boundary considered for this fire and fuels analysis, as it is considered that activities beyond that time period are no longer contributing to effects within the analysis area.

Environmental Effects

Direct and Indirect Effects - Alternative 1, No Action

Under the no action alternative, current and existing management plans would continue to guide the project area. No mechanical treatment or prescribed burning is being proposed, and wildfire would continue to be managed with protection and/or resource benefit objectives.

Implementing the no action alternative would allow the ecosystem to move toward more unsustainable characteristics. Canopies would continue to close and create continuous fuel across the landscape, and continue the potential for high severity fire effects (passive and active crown fire potential). This canopy fuel accumulation would have negative effects on understory vegetation and would continue to suppress the production of forbs, grasses, and shrubs. Over time, it is expected that most of the forest would have little to no understory due to sunlight not penetrating the canopy.

Basic fire behavior outputs for a Fuel Model TL8[10] would remain unchanged; Rates of Spread could be expected to range between 1 to 15 chains/hour (66-990 feet/hour) with a 20-foot flame length with wind speed between 0 to 40 miles per hour. Flame lengths would range between 1 to 7 feet and demonstrate resistance to control and require mechanized equipment for suppression operations on flame lengths at 4 feet or greater.

The combination of abundant and continuous canopy fuels, the lack of understory vegetation and high fire severity potential remains in the project area for the foreseeable future. High intensity fire behavior patterns can cause long-range spotting, compromise firefighter, and public safety, reduce soil productivity and remove valuable nutrients in the soil that promote stand regeneration post wildfire. The no action alternative shows continued potential for passive and active crown fire, and indicates more resistance to control and spotting potential.

Forest Vegetation Simulator and the Fire and Fuels Extension (Results for both Alternatives

All results from the Fire and Fuels Extension are stand averages giving a general idea of what stand conditions look like but do not address the spatial distribution of specific metrics. The desired conditions

[10] Fuel Model TL8 - Fuel bed composed of long-needle pine litter. TL8 moderate load and compactness may include small amount of herbaceous load. Spread rate moderate; flame length low.

for stand averages allow for some areas within a stand to be outside of the desired condition range but surrounded with conditions closer to the overall desired conditions. For example, crown base height is desirable to be above 35 feet as an average over a ponderosa pine stand. This could mean that many patches within the stand may have a higher crown base height or a lower crown base height but the overall average for the stand is within acceptable limits.

As seen in table 2 below, the fire and fuels extension to the forest vegetation simulators the Proposed Action improves crown base height, torching index, and flame length when compared to the no action alternative. The Proposed Action does not fully meet the desired conditions for each vegetation type; however, it does improve conditions and moves the overall conditions towards the desired condition. With no management action, continued risk for high intensity wildfire within the project area would continue to be present.

Table 2. Fire and fuels extension to the forest vegetation simulator results: No Action Alternative vs. Proposed Action post treatment (mechanical and prescribed fire, or mechanical only in the Pinyon Juniper)

Vegetation Type	Indicators	No Action Existing Conditions	Proposed Action	Desired Condition
Pinyon Juniper	CBH (feet)	6.81	11.50	12
	TI (mph)	11.72	23.45	25
	FL (feet)	9.14	6.74	4
Ponderosa Pine	CBH (feet)	10.97	45.22	35
	TI (mph)	18.76	138.79	25
	FL (feet)	11.33	3.75	4
Mixed Conifer	CBH (feet)	2.43	4.61	6
	TI (mph)	4.62	12.68	25
	FL (feet)	27.46	9.93	4

CBH= Canopy Base Height, TI= Torching Index, FL= Flame Length

Cumulative Effects- Alternative 1, No Action

Under the no action alternative, the Burnt Corral project area would continue to be considered a high fire risk area along the Kaibab Plateau with high potential for severe fire effects that impact property, public and firefighter safety. Cumulatively, when added to other projects across the Kaibab Plateau the ecosystem would mostly move toward characteristics that are unsustainable across the Kaibab Plateau. Canopies would continue to close and create continuous fuel across the landscape, and continue the potential for high severity fire effects. Cumulatively, the fuel accumulation would continue to suppress the production of forbs, grasses, and shrubs across areas that are not treated. This higher risk may be lowered if the Kaibab Plateau Ecological Restoration Project is approved through the NEPA process and implemented within the next 10 to 30 years.

Direct and Indirect Effects - Alternative 2, Proposed Action

The Proposed Action includes the use of mechanical treatments and prescribed burning to reduce the potential for uncharacteristic high intensity wildfire events in order to protect and maintaining key ecosystem components. The priority would be a reduction in vegetation density to provide for firefighter and public safety, promote forest health, and reduce the potential effects of a high intensity wildfire. The entire project area may receive prescribed fire treatments (approximately 28,090 acres). Prescribed fire treatments could involve broadcast burning, jackpot burning, and pile burning. Both mechanical and

prescribed fire treatments would follow both the forest plan regarding northern goshawk and visual quality guidelines, and reduce stand density to restore forest health, resilience, and resistance to destructive crown fire.

In most areas, the mechanical treatments would be followed with prescribed fire or be treated with a standalone prescribed fire treatment. Broadcast burns would aim to reduce surface fuel loads to the desired tons per acre. Mechanical and prescribed fire treatments would focus on creating surface fuel loads and tree canopies that are more prone to surface fire and are more resistant to passive and active crown fires.

Pinyon Juniper Vegetation Type

The Proposed Action in the Pinyon-Juniper stands improves canopy base height to 11.5 feet, increases the torching index to 23.45 mph and lowers flame length to 6.74 feet. This type of expected fire behavior is likely to exhibit torching (passive crown fire) and less likely to produce lofted embers that start more fires, and these fires generally burn cooler and slower and typically burn in the surface fuels. Fire behavior that would occur under these conditions ranges from creeping surface fires with flame lengths less than one foot burning in conifer litter and duff, to active surface fire burning freely in all surface fuels, and actively torching groups of seedling and sapling sized (1 to 6-inch diameter) trees.

Fires that are more active may also occasionally torch out individual overstory trees of various sizes as well as small groups of overstory trees with continuous ladder fuels beneath them. These desired forest conditions would provide for diversity within stands without sustaining crown fire. These types of fire are less likely to cause high fire severity effects, less ecosystem damage, and move the forest towards desired conditions. By moving towards these desired conditions for surface and canopy fuels, fire would be allowed to function as a natural disturbance within the Pinyon Juniper ecosystem without causing loss to ecosystem function or to human safety, lives and values. The desired forest conditions would provide for diversity within stands without sustaining crown fire. These conditions would allow managers to use wildfire and prescribed fire to maintain fuel accumulations within the desirable range, assist in maintaining desirable stand structure, and otherwise let fire perform its role as a natural disturbance factor within the ecosystem. Both broadcast and pile burning treatments could occur in this vegetation type.

Ponderosa pine Vegetation Type

The Proposed Action in the ponderosa pine stands improves canopy base height to 45.22 feet, increases the torching index to 138.79 and lowers flame length to 3.75 feet. This type of expected fire behavior is likely to exhibit torching (passive crown fire) and less likely to produce lofted embers that start more fires, and these fires generally burn cooler and slower and typically burn in the surface fuels. Fire behavior conditions that would occur under these conditions would range from creeping surface fires with flame lengths less than one foot burning in conifer litter and duff; to active surface fire burning freely in all surface fuels, and actively torching groups of seedling and sapling sized (1 to 6-inch diameter at breast height) trees. The more active fires may also occasionally torch out individual overstory trees of various sizes as well as small groups of overstory trees with continuous ladder fuels beneath them.

These desired forest conditions would provide for diversity within stands without sustaining crown fire. These types of fire are less likely to cause high fire severity effects, less ecosystem damage, and move the forest towards desired conditions. By moving towards these desired conditions for surface and canopy fuels, fire would be allowed to function as a natural disturbance within the ponderosa pine ecosystem without causing loss to ecosystem function or to human safety, lives and values. The desired forest conditions would provide for diversity within stands without sustaining crown fire. These conditions would allow managers to use wildfire and prescribed fire to maintain fuel accumulations within the

desirable range, assist in maintaining desirable stand structure, an otherwise perform its role as a natural disturbance factor within the ecosystem. Broadcast and pile burning prescribed fire treatments would occur in this vegetation type under the Proposed Action.

The pre-treatment fuel model TL8 would move towards a Fuel model TL3; both rates of spread and flame lengths would decrease. Rates of spread for a Fuel Model TL3 would range from 0.5 to 4 chains per hour (33 to 264 feet/hour) and flame lengths could range from 6 inches to 2 feet. The lower flame lengths indicate that overall fire behavior would primarily exhibit surface spread and the potential for passive and active crown fire events has been reduced significantly.

Mixed conifer Vegetation Type

The Proposed Action in the mixed conifer stands improves Canopy Base Height to 4.61 feet, increases the Torching Index to 12.68 mph and lowers Flame Length to 9.93 feet. This type of expected fire behavior is likely to exhibit torching (passive crown fire) and less likely to produce lofted embers that start more fires, and these fires generally burn cooler and slower and typically burn in the surface fuels. Fire behavior conditions that would occur under these conditions would range from creeping surface fires with flame lengths less than one foot burning in conifer litter and duff; to active surface fire burning freely in all surface fuels, and actively torching groups of seedling and sapling sized (1 to 6-inch diameter) trees. The more active fires may also occasionally torch out individual overstory trees of various sizes as well as small groups of overstory trees with continuous ladder fuels beneath them. These desired forest conditions would provide for diversity within stands without sustaining crown fire. These types of fire are less likely to cause high fire severity effects, less ecosystem damage, and move the forest towards desired conditions.

By moving towards these desired conditions for surface and canopy fuels, fire would be allowed to function as a natural disturbance within the ecosystem without causing loss to ecosystem function or to human safety, lives and values. The desired forest conditions would provide for diversity within stands without sustaining crown fire. These conditions would allow managers to use wildfire and prescribed fire to maintain fuel accumulations within the desirable range, assist in maintaining desirable stand structure, an otherwise perform its role as a natural disturbance factor within the ecosystem. Broadcast and pile burning prescribed fire treatments would occur in this vegetation type under the Proposed Action.

All Vegetation Types

Wildland fire would be allowed to function as a natural disturbance agent within all three primary vegetation types, except for certain areas within the Bridger Knoll fire area, on sensitive soils, steep slopes, and in seed cuts or plantation areas. For analysis the project area has been divided into four potential burn blocks to display the potential size of future burn blocks and to assess the potential amount of pre-burn preparation activities that may be required. Individual prescribed fire burn plans would be developed for each individual treatment unit. Each prescribed fire burn plan would be developed in coordination with the North Kaibab Ranger District interdisciplinary team. Individual prescribed fire goals, objectives, and treatment prescriptions would be developed for each project. These goals and objectives would be developed to utilize fire as a tool to assist in moving this ecosystem type towards the desired conditions for this vegetation type.

Based on the unit design pre-burn preparation activities along individual burn unit boundaries could involve treating approximately 920 acres. Standard pre-burn prep typically involves reducing dead and down fuel concentrations and reducing understory tree densities within 100 feet of the identified burn unit boundaries. This prep buffer improves firefighter and public safety and reduces the threat of the fire treatment leaving the treatment area. Additionally, control line or hand-line may be required to construct

or tie in individual burn unit boundaries. Many burn unit boundaries would involve utilizing the existing roads within the project area. Short sections of control line may be required and overall control line that may need to be constructed for this project would be less than five miles. Based on the preliminary planning for burn unit layout, it was estimated less than 2 miles of control line construction would be required. All control lines would be rehabbed post-fire treatment; therefore, effects would be short-term (2 to 5 years) when compared to the project completion timeline (15 to 20 years).

Cumulative Effects- Alternative 2, Proposed Action

Vegetation treatments, past timber sale activity, and large wildfires on the Kaibab Plateau have contributed to the current condition and would continue to shape the future stand conditions for the area. Over the past 20 years, management surrounding the project area has included wildfire suppression, prescribed burning, pile burning, mechanical thinning and various timber harvests as well as grazing and wildlife focused projects. Twenty years is the temporal boundary considered for this analysis, as it is considered that activities beyond that time period are no longer contributing to effects within the analysis area.

Several other projects are adjacent or are near individual treatment areas. In 2006, the Warm Wildland Fire Use fire treated approximately 19,000 acres of vegetation near the Jacob Lake area. The Warm Fire Use reduced fuel loading and has provided an increase in grasses, forbs, and shrubs. During the summer of 2018, the following fires were managed to meet land management objectives: Cat 4,497 acres, Stina 2,606 acres and the Obi 11,656 acres, treating approximately 18,759 acres. During the summer of 2019, the following fires were managed to meet land management objectives: Castle 19,368 acres and the Ikes 16,416 acres, treating approximately 35,784 acres. These 19,000 acres of improved fuel hazard conditions in combination with the 1,734 acres of improved conditions resulting from Plateau Facilities Fire Protection Project (PFFPP) facilities near Jacob lake and the Warm Fire Use area, fires from both 2018 and 2019 managed to meet land management objective of 54,543 acres makes a cumulative benefit of 75,277 acres.

The Moquitch Categorical Exclusion project is treating approximately 10,000 acres of forested land south/southwest of the ponderosa pine forest located near Jacob Lake. The Moquitch project is reducing the threat of high intensity wildfires by thinning understory trees, pile burning, and broadcast burning to improve safety for firefighters and the public. This project provides cumulatively additive beneficial effects when combined with the Proposed Action of this project for reduced fuel hazard.

The Jacob Ryan Vegetation Management Project is treating approximately 27,000 acres to the northeast and southwest of, and surrounding the Jacob Lake Lodge area. This project includes mechanical thinning followed by prescribed burning in phases over several years to increase wildlife habitat, reduce surface fuel conditions, and improve overall forest health. This project is additive to the Burnt Corral project as a beneficial effect for reduced fuel hazard.

The District completed work on the Fracas Wildlife Project; approximately 3,500 acres, to the south/southwest of the Jacob Ryan project area. This project included mechanical thinning followed by prescribed burning in phases over several years to increase wildlife habitat, reduce surface fuel conditions, and improve overall forest health. Between 2010 to 2011, approximately 3,500 acres were treated with prescribed fire in the Fracas Wildlife project area with success and the area is moving towards a fire adapted uneven-aged stand structure. This project is also additive to Burnt Corral as a beneficial effect for reduced fuel hazard.

Another foreseeable project would be the Tipover Vegetation project with addition of about 10,000 acres of under burning to promote fire resistance. This area was harvested with individual selection treatments in the late 1980s and would respond to the treatment with aspen regeneration and fuels reduction.

Another foreseeable project would be the Kaibab Plateau Ecological Restoration Project that is proposing treating approximately 319,000 acres with prescribed fire. The project encompasses the North Kaibab Ranger District excluding the Burnt Corral Project Area and the two wilderness areas. The project would be carried out over approximately the next 20 years. The project is designed to reduce the threat of uncharacteristic high-severity wildfire and restore fire-resilient conditions on the Kaibab Plateau. Based on the location of Burn Blocks, planning for fire and fuels activities regarding Burnt Corral and the Kaibab Plateau Ecological Restoration Project would be coordinated to ensure that restoration is achieved to meet applicable project objectives.

The combined effect of these ongoing projects on the Kaibab Plateau would provide for restoration and fuel reduction and would provide for a mosaic of stand conditions, allowing for wildlife habitat and vegetative diversity. This same mosaic would allow for a diversity of fire effects thereby increasing opportunities for the maintenance of forest structure and function using natural and prescribed fire in the long-term future. The Proposed Action would continue to create a mosaic of fuel along the Kaibab Plateau. The proposed activities in the project area would provide for fewer negative effects from aggressive fire suppression activities and severe fire behavior.

Soil, Watershed, and Air (See "Soil, Watershed, and Air Specialist's Report," USDA May 2018a)

Spatial and Temporal Context for Effects Analysis

Soils

Elevations within the project area range from 6,800 feet above mean sea level near Pine Hollow Trick Tank. And, in the northwest to 8,096 feet above mean sea level near Road Hollow Tank in the southeast. Slopes range from nearly flat (less than 5 percent) to 65 percent with steeper slopes generally occurring along canyons of the western and southern portions of the project area. Currently, most soils within the project area exhibit an abundance of organic matter in a variety of size classes. Excessive accumulations of woody debris can result in high intensity fires, resulting in large losses of soil organic matter (Harvey 1994). There are approximately 1,415 acres of soils that are in unsatisfactory condition due to erosion rates that are exceeding tolerance thresholds. These soils generally exhibit less organic matter and vegetative ground cover than required to maintain soil productivity and prevent soil loss. Approximately 965 acres of unsatisfactory soils within the project area are found within the Bridger Knoll Fire burned area. These include map units 271 (521 acres) and 274 (444 acres).

Watersheds

The Burnt Corral Project occurs in six HUC12 sub watersheds. Table 3 provides a summary of watershed condition ratings, acres within the project area, and total watershed acres.

Table 3. Sub watersheds (HUC12) in the Burnt Corral Project, their current condition ratings, total watershed acres, and total acres within the project area

Watershed Name	Hydrologic Unit Code (HUC12)	Condition Rating	Total Watershed Acres	Watershed Acres within BC Project Area	Project Acres as a Percent of Watershed (HUC 12 acres)
Castle Canyon	150100030701	Functional at risk	11,168.7	0.7	0.006
Indian Hollow	150100031002	Impaired	32,672.6	3,986.4	12.2
Jumpup Canyon	150100031003	Functional at risk	36,877.2	5,987.1	16.2
Lookout Lakes	150100030702	Impaired	38,718.6	3,108.3	8.03
Nail Canyon	150100030705	Impaired	17,600.9	1.2	0.006
Sowats Canyon	150100031001	Impaired	39,565.0	15,002.5	37.9
Total			**176,603.0**	**28,086.2**	

Water Quality and Quantity

There are no perennial running waters within the project area, and therefore no surface water quality data for the project area. No water bodies within the project area or on the North Kaibab Ranger District are listed as impaired on the Arizona 2012/2014/2018 Impaired Waters List.

There are no intermittent or perennial streams within the project area. Stream channels in this area exhibit only ephemeral flow characteristics. Streamflow only occurs for brief periods due to spring snowmelt and monsoon precipitation. Streamflow and runoff volumes within the project area are not monitored. There are no streamflow data for ephemeral channels within the project area. Typically, ephemeral drainages in the project areas exhibit bimodal seasonal flow patterns – typically during spring snowmelt and following localized, high intensity summer monsoon precipitation.

Air Quality

The project area is not located adjacent to large population centers, power plants, or industrial facilities. The closest coal-fired power plant to the project area is the Cholla Power Plant near Holbrook, Arizona. The project area is located approximately 155 miles west-northwest of the Cholla Power Plant. The prevailing southwest winds on most days of the year carry pollution from these power plants away from the North Kaibab Ranger District. It is unlikely that either of these power plants are causing adverse air quality impacts in the project area. The project area is located approximately 60 aerial miles east of Las Vegas, Nevada, 198 aerial miles north of Phoenix, Arizona, and 329 miles from Los Angeles, California. Pollution and haze from these and other urban/industrial centers have potential to adversely affect air quality in the project area. Visibility is sometimes affected by haze from these cities, but effects are minor. Wildfires and prescribed fires occasionally contribute smoke, particulates, and haze to the project area. Windblown or fugitive dust during periods of high wind can cause localized effects to air quality.

The North Kaibab Ranger District is not located within an air quality Non-Attainment Area designated by the Arizona Department of Environmental Quality. The closest Non-Attainment Areas are Las Vegas (CO, PM-10, and 8-Hour Ozone and Bullhead City Area for PM-10 (particulate matter) and the Phoenix Area for PM 10 and ozone.

The Kaibab National Forest must submit prescribed burn plans to Arizona Department of Environmental Quality for approval in order to minimize the effects of smoke, but it is not required to reduce fugitive

dust or vehicle emissions at this time. Many roads in the project area are unpaved. These gravel and native surface roads are sources of fugitive dust in dry weather, especially when there is frequent vehicle traffic. Vehicles driving cross-country may also create fugitive dust. Fugitive dust impacts to air quality are generally localized and short term.

The Kaibab Plateau area is heavily used as a recreation area for many people. This area represents clear and clean air for many visitors and is important to the continued health of surrounding communities both economically and physically. Smoke, in general, is a nuisance and can be adverse to health, but is also part of the natural disturbance associated with these types of ecosystems. Both prescribed and wildfires create smoke, however the amount and timing of these smoke events can be mitigated with prescribed fire. Any prescribed burning would be conducted only with approved site-specific burn plans with standard smoke management mitigation and approvals. Burning would be conducted in favorable atmospheric conditions to minimize effects from smoke to nearby communities and recreationist. All burning would be conducted according to Arizona Department of Environmental Quality Regulations. These regulations ensure that effects from all burning within the area are mitigated and that Clean Air Act requirements are met.

In general, prescribed fires are initiated under conditions that allow managers to control for favorable effects. Prescribed fires would be conducted when conditions are such that overstory tree mortality would be low, which leaves much of the live-tree carbon pool intact. This results in less biomass being combusted than if the area were to burn under higher severity wildfire and therefore less carbon emissions (Wiedinmyer and Hurteau 2010). Smoke impacts from wildfire are less easily mitigated. Wildfires primarily occur during summer months when the project area is most heavily used by recreationist and therefore would most likely have more of an impact on recreation values. The amount of biomass consumed by fire the more smoke that would be produced.

When comparing alternatives, the Proposed Action alternative proposes prescribed burning which would have an impact on surrounding communities and recreationist but in a controllable manner. The outcome of this alternative would also reduce the amount of biomass available to fire during wildfire which would reduce the impact of smoke from such a wildfire. The no action alternative does not propose any prescribed burning; however; it would continue to maintain large amounts of biomass available for consumption in the event of a wildfire, which would have direct and most likely uncontrollable impacts on recreation and surrounding communities.

Environmental Effects

Direct and Indirect Effects - Alternative 1, No Action

There would be no direct effects to soils and water quality because of the no action alternative. However, in the absence of fire, indirect effects include herbaceous ground cover that would continue to decline as forest ingrowth and densification continues. The depth and areal extent of the soil litter layer would increase, thereby excluding the establishment and propagation of grasses and forbs. Terrestrial Ecosystem Survey map units would not benefit from the introduction of coarse woody debris that would occur rapidly through vegetation treatments as described in the Proposed Action.

Watershed conditions would continue to decline under the no action alternative. This is due to the fire regime condition classes that further deviate from the historic range of variation. Surface litter and fuel loads would continue to increase, resulting in greater risk of uncharacteristic wildfire and higher soil burn severities. Where natural ignitions occur, the resulting higher burn severities would increase sediment delivery to stream courses, increase channel incision (downcutting) and aggradation, scour and bank failure. Surface water quality would also be compromised. Conditions would be conducive to increased

hazard of high severity wildfire that would result in large areas of hydrophobic soils that would be prone to erosion and sediment delivery to ephemeral and intermittent drainages.

Cumulative Effects- Alternative 1, No Action

No direct effects would occur as the result of the no action alternative, thus no cumulative effects are anticipated. However, as described in the indirect effects section, in the absence of fire, herbaceous ground cover would continue to decline as forest ingrowth and densification continues. The depth and areal extent of the soil litter layer would increase across the area, thereby excluding the establishment and propagation of grasses and forbs. The Terrestrial Ecosystem Survey map units would not benefit from the introduction of coarse woody debris that would occur rapidly through vegetation treatments as described in the Proposed Action.

Watershed conditions would continue to decline under the no action alternative. Where natural ignitions occur, the resulting higher burn severities would increase sediment delivery to streamcourses, increase channel incision (downcutting) and aggradation, scour and bank failure. Surface water quality would also be compromised. Conditions would be conducive to increased hazard of high severity wildfire that would result in large areas of hydrophobic soils that would be prone to erosion and sediment delivery to ephemeral and intermittent drainages. Cumulatively, exclusion of fire in the project area could have negative effects to soil and water resources across the cumulative effects area.

Direct and Indirect Effects - Alternative 2, Proposed Action

Direct and indirect effects to soils, watershed condition and air quality as a result of the Proposed Action include:

- Reduction of the forest canopy would decrease interception (precipitation captured by leaves, branches, and boles) and increases net precipitation reaching the soil surface.
- Partial removal of the forest overstory reduces transpiration (water lost from plants to the atmosphere).
- Reductions in interception and transpiration increase soil moisture content, water available for plant uptake, and water yield.
- Increased soil moisture and loss of root biomass can reduce slope stability.
- Increases in water yield after forest thinning are transitory and decrease over time as forests regrow unless subsequent treatments maintain initial post-treatment conditions.
- When young, dense forests with high interception rates (or higher annual transpiration losses) replace mature forests with lower interception rates (or lower transpiration losses); water yield is reduced until the young forest matures and thins naturally or is thinned in treatments.
- Impervious surfaces (roads and trails) and altered hillslope contours (cutslopes and fillslopes) modify water flowpaths, increase overland flow, and deliver overland flow directly to stream channels.
- Impervious native surfaces increase soil erosion.
- Altered hillslope contours and modified water flowpaths along roads increase risk of landslides.
- Particulate emissions from prescribed and managed fires that could adversely affect human health.
- Dust from roads could affect visibility and adversely affect human health
- Nuisance smoke

Potential adverse effects of the Proposed Action on soil productivity would include soil compaction, puddling, displacement, erosion, areas of high soil burn severity, loss of soil organic matter, short-term changes in soil moisture content, changes in nutrient cycles, and changes in soil fauna. These effects can result from mechanical and non-mechanical vegetation treatments (such as forest thinning and prescribed fire), mechanical and non-mechanical piling of activity-related debris, fireline installation, and temporary road construction, maintenance, and decommissioning activities. Mechanical forest vegetation treatments have the potential to adversely affect water quality through introduction of sediment and additional nutrients from decomposing woody debris, particularly in thinned areas adjacent to stream courses. Implementation using or applying best management practices and soil and water conservation practices as outlined in the design features (see appendix A – design features; soils and watershed) minimize adverse impacts to soils and water quality from these activities.

Soil compaction, puddling and displacement would primarily be limited to the transportation systems and high traffic areas within mechanical vegetation treatments such as existing National Forest System roads, temporary access roads, skid trails, log landings, debris piling areas, and areas where fireline construction occur. Road closures and curtailment of mechanical vegetation treatments during wet weather conditions and designation of authorized access routes (skid trails and temporary roads) and log landing locations within the project area prior to project implementation would minimize adverse effects to soil productivity caused by these activities. With implementation of applicable best management practices and soil and water conservation practices as outlined in the soil and watershed design features (see appendix A), most adverse effects to soils would be minimized or mitigated. Additionally, seasonal wetting and drying, freezing and thawing, and soil organism activity would naturally ameliorate some adverse effects to soils caused by the Proposed Action.

The effects of the proposed forest restoration activities on erosion and sediment yields depend on methods and equipment used, skills of the equipment operators and personnel conducting the treatments, site-specific conditions, storm event timing and intensity, and prescribed fire locations and burn severities. Erosion rates for each terrestrial ecosystem survey map unit in the Burnt Corral project area were modeled as part of the Soils and Watershed analysis. [MacDonald, 2018, as updated by Kiesow, May. 2018a) The analysis shows that soil erosion rates from the combined effects of forest thinning and prescribed fire would not exceed tolerance erosion rates for any of the terrestrial ecosystem survey map units in the project area.

The risk of short-term accelerated soil erosion would be expected to increase in areas where forest thinning and use of prescribed fire results in extensive soil disturbance or complete removal of vegetative ground cover. These areas are expected to include skid trails, log landings, temporary access roads, decommissioned temporary roads, installed firelines and National Forest System roads.

The removal of forest cover can decrease raindrop interception and evapotranspiration, which can increase water yields from treated areas (Bosch and Hewlett 1982, Stednick 1996). In areas where the annual precipitation is less than 20 in (500 mm), removal of the forest canopy does not typically increase annual water yields (Bosch and Hewlett 1982). In drier areas, such as the proposed project site, the decrease in interception and transpiration caused by forest thinning is usually offset by the increase in soil evaporative losses, resulting in no net change in runoff as long as factors affecting runoff processes are not changed (MacDonald and Stednick 2003). Evapotranspiration rapidly recovers with vegetative regrowth in partially thinned forests. Increases in runoff due to thinning operations rarely persist for more than 5 to 10 years, unless maintenance treatments are implemented.

Thinning of forest cover on soils currently characterized as unsatisfactory would improve soil conditions over the long-term by improving soil moisture and allowing greater sunlight penetration to the forest floor

resulting in an increase in grasses, forbs and shrubs in the forest understory. The increased woody debris and herbaceous vegetation would reduce soil erosion rates by providing vegetative and litter ground cover that would intercept rain before it can reach soil surfaces and detach and entrain soil particles in runoff. Woody debris from forest thinning (such as slash) would be lopped and scattered where doing so would not result in excessive fuel loads and increased wildfire risk, further mitigating potential adverse effects to these soils. Fine woody debris that is incidental to forest vegetation treatments (such as needles, leaves, twigs, cones, bark, etc.) would also remain on the ground following mechanical treatments to protect soil surfaces from wind and water erosion.

Prescribed fire that would occur as a result of project activities has the potential to impact water quality by increasing sediment yields, dissolved solids, and nutrients in runoff. Dissolved nutrients in stream flow primarily originate from weathering of parent materials and soils, decomposition of plant material and other organic matter, and anthropogenic sources. Vegetative communities accumulate and cycle nutrients (Tiedemann et al. 1979, 1980). Fire can disrupt nutrient cycling and cause nutrient volatilization, leaching, and transformations. When vegetation is consumed by fire, some of the soil and organic matter nutrients such as nitrogen, phosphorus, copper, iron, manganese, and zinc are volatilized and lost from the system, while other nutrients such as calcium, magnesium, and potassium are converted into oxides and accumulated in ash (DeBano et al. 1998). Debris on the forest floor from thinning and logging slash also helps mitigate the effects of prescribed fire.

The mobility and concentration of nutrients in soils determines whether nearby water sources are at risk of contamination when prescribed fire is used. Nitrate is highly mobile and is therefore subject to risk of being leached from burned areas and transported to either surface or ground water. Phosphorus adsorbs readily to sediment and organic materials. Thus, phosphorus is usually transported to streams and water bodies through soil erosion. Rates of soil erosion and phosphorus contamination are generally dependent on soil characteristics and topographic relief of the site.

Prescribed fire has the potential to alter short- and long-term soil productivity and moisture content by changing the amount and type of vegetation, the amount of forest floor organic matter, and surface soil texture and wettability. Prescribed fires typically leave greater amounts of organic matter (duff, forest litter, and large and small woody debris) on soil surfaces than uncontrolled fires. These materials serve as nutrient sinks, prevent soil particle detachment caused by raindrop impact, and capture sediments that would otherwise be transported to stream channels and waterbodies. Following low-severity prescribed fires, an increase in grasses and other herbaceous vegetation often occurs. This rapid regrowth of ground cover further immobilizes nutrients in plant material. Effective surface prescribed fire also prepares the seedbed for successful natural regeneration and/or tree planting.

Prescribed fires that remove large amounts of vegetation from a site have potential to alter watershed hydrology. As vegetation is removed, evapotranspiration in the watershed decreases, thus providing greater stream flow and overall water yield within the watershed. Water uptake from trees is species-specific. Conifers, which are the dominant vegetation type within the Burnt Corral Project area, generally transpire greater quantities of water than hardwoods such as oaks and aspen. Dense foliage and longer growing seasons promote the higher overall water uptake in conifers. Additionally, conifers have relatively dense crowns that intercept rainfall and allow for greater evaporative losses.

Once a site has undergone loss of vegetation and removal of the litter layer, surface runoff can cause increased erosion and greater stream discharges. Fires not only consume portions of the litter layer, but at high temperatures, fires can also cause hydrophobic soil conditions, thus making soils more susceptible to erosion. DeBano and Krammes (1966) and Robichaud (2000) observed that water repellency was dependent on the heating temperatures of the soils. At typical wildfire soil profile temperatures (less than

500° F) when the soil was dry, soil hydrophobicity occurs at shallow depths (less than 1 inch). When soils are moist (conditions that commonly occur during prescribed fire in the spring and fall), soil hydrophobicity was less pronounced and only occurred after long heating times that would typically only occur during smoldering fires. Therefore, soil hydrophobicity under a prescribed fire scenario would likely be minimal throughout the majority of the project area.

Fire in southwestern ponderosa pine forests has been shown to generally increase soil moisture content (Ryan and Covington 1986, Ower 1985, Haase 1986). In a review of literature, Hungerford and others (1991) reported that burning can kill many kinds of bacteria, fungi and arthropods but the extent of this effect is dependent on the amount of heat generated by the fire and soil moisture content. To what extent these changes result in an impairment or degradation of soil productivity is not clearly understood. Hungerford suggests that low to moderate intensity prescribed fires may have minimal long-term negative effect on soil microorganisms. Kaye and Hart (1998) found that microbial nitrogen transformation rates increased under restored forest conditions, relative to the controls, suggesting higher microbial activity in the restored areas. Neary and others (1999) caution against the adverse effects to soil microorganisms caused by fires that become intense or are too frequent. Researchers have recommended maintaining soil carbon pools to maintain biologic activity (Stark and Hart, 1997), and recommend maintaining heterogeneity in burned areas to provide suitable sites from which the microflora and microfauna can reestablish in burned areas (Moldenke, 1999).

Prescribed fires under the Proposed Action are expected to be of low severity with small areas of medium and high severity, retaining unburned islands and creating a mosaic of fire effects. Low and medium severity fires burn only a portion of the surface organic matter – leaving adequate soil cover over much of the burned area to protect soil surfaces. In general, low severity prescribed fire does not cause excessive erosion or sediment transport since soil cover is retained in a discontinuous pattern across the landscape. This type of prescribed fire would not have a long-term adverse impact on soil moisture content or biota. The increase in understory vegetation as a result of implementing this project would improve long-term soil structure and porosity through increased fine root volume and vegetative litter, which are important habitat components for soil fauna that then incorporate organic matter into soil profiles and facilitate nutrient cycling.

Areas of high severity fire may consume forest floor organic matter, leaving soils hydrophobic (repellant to water) and susceptible to erosion. Implementing prescribed burning under conditions that would minimize high severity fire would minimize areas where soil organic matter is totally consumed and prevent hydrophobic soil conditions. Initially, the greatest risk of soil erosion would most likely occur in areas where prescribed fire is implemented prior to forest thinning treatments. This is due to greater amounts of woody debris on the ground and higher stand and crown densities at these locations, which increases the risk of high severity fire.

Piling of activity-related debris (slash) would disturb soil surfaces, exposing them to direct raindrop impact and wind. On steep terrain, this would increase localized, short-term erosion rates in areas where piling of woody debris is conducted. Additionally, use of excavators with hydraulic bucket thumb attachments rather than dozers would minimize soil disturbance during machine piling. Installation of firelines where they do not currently exist would expose soil surfaces, increasing the risk of erosion by both wind and rain. Rehabilitation of firelines following prescribed burning would minimize adverse impacts to soil productivity from fireline installation. Burning of slash piles has been shown to negatively affect soil biotic and chemical properties due to intense soil heating (Korb et al, 2004 and Seymour and Tecle, 2005). It can result in soil sterilization, increased erosion risk and an increased risk of invasive and noxious weeds that displace native vegetation.

Pile burning sites would constitute a small portion of the project area (less than 5 percent). However, the damage to soil chemical and physical properties from burning of debris piles can persist on the landscape for many years. Implementation using or applying Best Management Practices and Soil and Water Conservation Practices as outlined in the design features including use of the rack-and-pile method would mitigate most adverse effects from piling of woody debris and burning of this material after forest thinning. Monitoring of debris pile burning sites for the presence of invasive or noxious weeds following pile burning, and treatment of any infestations found would mitigate most adverse effects to soils caused by pile burning of slash.

Soil organic matter serves as the long-term nutrient supply for all vegetation occupying a site. It also provides microhabitat for most soil organisms and improves soil chemical and physical properties including soil aggregate stability, increased porosity and water holding capacity, lower bulk densities, and improved nutrient cycling. Initially, there would be an expected short-term increase in soil organic matter as a result of mechanical vegetation treatments as woody debris is deposited on soil surfaces during treatments. Forest thinning would also allow greater light penetration to soil surfaces resulting in warmer soil temperatures. The reduction in tree vegetative cover because of forest thinning would decrease evapotranspiration rates and therefore increase soil moisture.

Warmer soil temperatures and greater soil moisture content would result in increased soil biological activity. Increased soil biological activity results in a proportional decrease in soil organic matter as organisms consume soil detritus. The eventual increase in understory vegetation would result in increased litter fall and deposition of organic matter onto soil surfaces. Broadcast prescribed fire would result in rapid oxidation of surface organic matter and living understory biomass, causing a release or transformation of some soil nutrients.

Runoff from road surfaces can detach and entrain fine material from road prisms and ditches. Sediment delivery directly from road surfaces to water courses is difficult to estimate since it occurs as part of non-point source runoff. Sediments delivered to streams from roadside ditches may have originated from sheet or rill erosion prior to entering road surfaces or drainage ditches. In the absence of vehicle traffic, sediment concentrations in road runoff decreases over time. However, vehicle traffic, particularly trucks, can pulverize road surface aggregates, resulting in more fine particles that are easily transported in runoff. Additionally, the pressure of vehicular tires on saturated road surfaces can force fine particles from below the surface to move upward to the surface (Truebe and Evans 1994).

Road proximity and connectivity to drainages can strongly influence sediment delivery to watercourses and peak flows in streams. Roads within the project area intersect numerous ephemeral drainages. These points of intersection occur as both culverted crossings and low-water crossings. Road-stream intersections are the primary location where sediments are delivered to stream courses. Implementation using or applying best management practices and soil and water conservation practices as outlined in the design features would minimize or mitigate adverse effects to soil productivity and water quality from road use and maintenance and temporary road construction, use and decommissioning. With implementation of these design features, including monitoring to assure proper implementation and effectiveness soil erosion thresholds would not be exceeded and there would be no long-term adverse effects to water quality.

Cumulative Effects- Alternative 2, Proposed Action

The geographic setting for the cumulative effects analysis for soils and watersheds includes all the 6th-level (HUC12) hydrologic unit watersheds where the Burnt Corral Restoration Project is located, which comprises approximate 176,603 acres. The timeframe for past actions is 10 years, based on soil

productivity, vegetative response, and coarse woody debris recovery within treated areas. Surface disturbing activities that are older than 20 years are assumed to be contributing negligible or no measurable cumulative effect within the analysis area. The timeframe for future actions is 20 years, based on implementation for other projects within the cumulative effects area.

Following is a listing of actions considered in the cumulative effects analysis for this project:

- Activities such as vegetation and fuels management, livestock grazing, recreational activities, and other activities (noxious weeds treatments) have occurred in the past, are occurring, and are reasonably foreseeable actions on the North Kaibab Ranger District.
- Firewood cutting has occurred in the past and would likely continue in the foreseeable future on the District within watersheds that include the project area.
- Road maintenance, reconstruction, or decommissioning may occur with future vegetation projects on National Forest System land.
- Recreation activities are expected to continue to increase on the Forest. Future recreation projects may be developed.

Specific past, present and foreseeable future actions include:

- Plateau Facilities Fire Protection Project
- Jacob-Ryan Vegetation Management Project (a.k.a. Jacob-Ryan)
- Moquitch Habitat Improvement Project
- Burnt Saddle, Pine Hollow, and Lookout timber sales
- Salvage logging in the Bridger Fire
- Westlake Project
- Big Saddle Project
- Kaibab Plateau Ecological Restoration Project

The Plateau Facilities Fire Protection Project and Jacob-Ryan project are near Jacob Lake. These project areas encompass approximately 30,000 acres and include similar activities as the Burnt Corral Project. Activities include mechanical thinning (pre-commercial thinning and commercial timber sales) on approximately 20,000 acres and use of prescribed fire on approximately 25,000 acres. These actions would improve forest health with reduce fire hazard and potential soil burn severity. Soils and watershed conditions would therefore be improved across the cumulative effects area following these activities as more robust understory vegetation begins to occupy sites currently dominated by litter. By reducing the risk of high soil burn severity, the risk of cumulative adverse effects to soils, watersheds, and water quality such as erosion and sediment delivery to drainages would be reduced.

The Moquitch Habitat Improvement Project would improve forest health, wildlife habitat, and reduce fire hazard on 10,000 acres in the ponderosa pine forest cover type and would occur east of Forest Road 462 and north of Forest Road 212, extending to the southern portion of the Jacob-Ryan Project. Approximately 75 percent of planned prescribed fire have been completed in this project area. Improved soils and watershed function are already being realized as a result of this project and when added to the effects of this project would cumulatively improve soil and watershed function. The understory of grasses and forbs has improved, thereby contributing to greater soil stability than litter alone. Reduced stand densities has resulted in a corresponding reduction in the risk to soils, watershed function and water

quality by reducing the potential for high soil burn severity. In combination with the Burnt Corral Project, there would be a positive cumulative effect to soils and water resources through increased spatial extent of forest conditions that are conducive to low severity fire and therefore improved soil stability and watershed condition, improved watershed function, and protection of water quality.

Past timber, sales in the Burnt Corral area include Burnt Saddle, Pine Hollow, and Lookout. The primary benefits of these projects are improved surface fuel continuity that promotes low intensity surface fire, more open stand structures, and effective fuel breaks. These treatments encompass approximately 9,620 acres, which include even-aged regeneration treatments that have established young forest. Intermediate thinning treatments were completed across approximately 85 percent of the acres that were commercial timber sales. The cumulative effects from these past management activities include forest openings that are large enough to prevent active crown fires. These projects, in conjunction with the Proposed Action would cumulatively improve soil health by preventing high soil burn severity that would increase soil erosion rates. Reducing soil erosion rates improves surface water quality and watershed function.

Salvage logging and reforestation occurred on approximately 1,360 acres in the Bridger Fire burned area. The cumulative effects of these activities include establishment of new forest cover in the form of advanced regeneration, and a future source of ponderosa pine seed within the burned area. This potential future timber and the associated seed crop would be protected from both managed and unmanaged wildfires. Salvage logging removes fuels that can contribute to high soil burn severity under both prescribed fire and wildfire conditions. Soil disturbance resulting from salvage logging did not result in long-term adverse effects to soils or watershed resources as exemplified by forest regeneration and increased vegetative ground cover, which has contributed to increased soil stability in most areas where salvage logging was conducted. There has been no direct adverse cumulative effect to soils or watershed resources from salvage logging. A positive cumulative effect of salvage logging is the reduced risk of reburn of dead trees within some areas of the Warm Fire where salvage logging has occurred. Cumulatively, sufficient coarse woody debris remains to provide beneficial nutrient cycles and soil recovery over time.

The Westlake project included approximately 1,130 acres of ponderosa pine forest thinning and hand piling of woody debris. This project was primarily thinning of small conifers from 2 feet tall in height to 8.9-inch diameter at breast height. The resulting woody debris was hand-piled until 2009, and the piles were burned. This treatment reduced the density of small trees, thereby reducing ladder fuels that can contribute to canopy fires. There is opportunity for future commercial timber sales in the Westlake Project area during implementation. The cumulative effect of the Westlake project in conjunction with the Burnt Corral project is reduced risk for high severity wildfire that could adversely affect soils and watershed resources. The cumulative effect of the Westlake project in conjunction with the Burnt Corral project is reduced risk for high severity wildfire that could adversely affect soils and watershed resources.

The Big Saddle thinning and lopping project is immediately adjacent to the southwest boundary of the Burnt Corral Project. This area is approximately 565 acres in size. Ponderosa pine trees from 2 feet tall in height to 8.9 inches diameter at breast height were removed. Wildfire hazard has therefore been reduced in this area and forest productivity improved. The reduced wildfire hazard and increased soil organic matter content through lopping and scattering of woody debris has improved soil condition. The additional organic matter provides for improved nutrient cycling, carbon sequestration and increased surface cover and roughness, which prevents soil erosion and sediment delivery to drainages. The overall effects of this project in combination with the Burnt Corral project is improved soils and watershed condition and protection of surface water quality.

The Kaibab Plateau Ecological Restoration Project is approximately 518,000 acres and encompasses most of the North Kaibab Ranger District of the Kaibab National Forest. The project proposes approximately 319,000 acres of prescribed fire supported by approximately 122,000 acres of noncommercial mechanical and hand treatments. The goal is to use prescribed fire at a frequency that would restore fire resilience to the landscape. This project would improve forest and watershed health while reducing fire hazard. In combination with the Burnt Corral Project, there would be a positive cumulative effect to soils and water resources through increased spatial extent of forest conditions that are conducive to low severity fire and therefore improved soil stability and watershed condition, improved watershed function, and protection of water quality.

All the projects described above cumulatively contribute to improved forest health and reduced fire hazard. Cumulative effects from projects within the cumulative effects analysis area including Burnt Corral would not contribute to soil loss rates above tolerance thresholds. Cumulative effects from temporary roads across all projects within the cumulative effects analysis area would be negligible and short-term since temporary road construction, use and decommissioning would be mitigated through best management practices. The cumulative effects include the following: a) improved soils health through increased herbaceous vegetative ground cover that prevents erosion and sediment delivery, b) improved nutrient storage and release, c) reduced sediment delivery to drainages, d) improved air quality due to reduced fuels that could otherwise burn for prolonged periods and create large amounts of smoke in an uncontrolled fire.

By moving the Burnt Corral, area to a more resilient and fire-adapted ecosystem, and reducing tree density and associated fuel loads to more historic conditions, the risk of stand-replacing wildfire that has profound adverse effects to soils, water quality and watershed condition would be reduced considerably.

Wildlife (See "Biological Evaluation and Wildlife Specialist's Report," USDA Dec. 2019d)

Spatial and Temporal Context for Effects Analysis

Forest types are highly influential to the wildlife species that inhabit them and play a role in habitat suitability. Most of the project is within ponderosa pine forest, and 98 percent of proposed mechanical treatments occur within ponderosa pine forest. Considering this, the spatial context for the effects analysis is the 165,000 acres of ponderosa pine forest in and surrounding the project area. The current plan for the project area would include re-entry to the area in about 25 years for site-specific management (mechanical or fire) where necessary, and given this time frame, the temporal context for the effects analysis is 25 years into the past, and 25 years into the future.

Environmental Effects

General Direct, Indirect, and Cumulative Effects - Alternative 1, No Action

Under the No Action alternative there would be no mechanical vegetation treatments or prescribed burning treatments. Management of wildland fire could still occur. Disturbances as a result of project implementation would not occur. No restoration efforts would take place and fuels hazard reduction would not occur, except as a result of managed wildland fire.

Direct and Indirect Effects - Alternative 2, Proposed Action

Federally Listed Species

Table 4 shows the project-specific species list provided by U.S. Fish and Wildlife Service for the project. Only these species would be analyzed here, other species that do not occur on the North Kaibab Ranger District would not be impacted by the proposed project.

Table 4. Effects determinations for wildlife species and critical habitats in USFWS official species list.

Species Name	Critical Habitat in Project Area?	Determination	Rationale
California condor *Gymnogyps californianus* (experimental population, non-essential)	No	Would not jeopardize the continued existence of population	See below
Mexican spotted owl *Strix occidentalis lucida*	Yes	May effect, not likely to adversely affect species, its habitat, and/or designated critical habitat.	See below
Yellow-billed cuckoo *Coccyzus americanus* (Western DPS)	No	No effect	No detections or suitable habitat in project area.
Northern Mexican gartnersnake *Thamnophis eques megalops*	No	No effect	No detections or suitable habitat in project area.
Humpback chub *Gila cypha*	No	No effect	No detections or suitable habitat in project area. USFS would implement soil and watershed best management practices.
Razorback sucker *Xyrauchen texanus*	No	No effect	No detections or suitable habitat in project area. USFS would implement soil and watershed best management practices.

California Condor

Direct and Indirect Effects - Alternative 1, No Action

Improved foraging and carrion availability for condors would not occur if no action were taken, unless there was a large wildfire. The no action would result in accumulation of fuels and potential for high-intensity wildfire, such as the 2006 Warm Fire.

Direct and Indirect Effects - Alternative 2, Proposed Action

The measures in appendix A would mitigate most short-term effects to the California condor. Noise from mechanical treatments, road maintenance/improvement, and helicopters may cause short-term avoidance of foraging in some areas during treatment. Similarly, smoke associated with prescribed fire may limit visibility-impacting foraging in some areas while treatments are being conducted. However, prescribed fire and thinning may benefit foraging condors over the long term by creating more open forest conditions. The increased herbaceous forage would result in enhanced mule deer habitat, and mule deer carrion is a major source of food for condors on the Kaibab plateau.

Determination

The Proposed Action may result in some short-term avoidance but would not jeopardize the continued existence of the California condor because the project does not treat condor nesting habitat and mitigation measures would minimize other effects. The Proposed Action may have long-term benefits for the species by creating some openings in the forest, increasing the availability of carrion.

Mexican Spotted Owl

Direct and Indirect Effects - Alternative 1, No Action

No action would affect key habitat elements (large trees, large snags, and large logs, hardwoods, etc.) similarly to the Proposed Action. However, Mexican Spotted Owl habitat would be at greater risk of high-intensity wildfire with no action, which can eliminate large areas of Mexican Spotted Owl habitat as the Warm Fire did in 2006. This type of fire is currently considered the biggest threat to Mexican Spotted Owl (USFWS 2012a).

Direct and Indirect Effects - Alternative 2, Proposed Action

Within Mexican Spotted Owl recovery habitat, the Proposed Action for mechanical treatment would: 1) retain all trees above 12-inch diameter at breast height. Trees would be thinned from below, up to 12 inches to reach proposed 120 sq. feet/acre basal area. In some areas, thinning to 9-inch diameter at breast height may occur to meet desired condition. Large snags (greater than 18-inch diameter at breast height), large downed logs (greater than 18-inch diameter at breast height) and large trees (greater than 18-inch diameter at breast height) would be maintained, and aspens, a key component of hardwoods, would not be mechanically treated but could be thinned by burning.

The proposed use of wildland fire is not expected to change large tree density, snag density, or ground layer species richness and cover in low and moderate-low severity areas within Mexican Spotted Owl Recovery Habitat. A decrease in small diameter trees would result in a decrease in the overall basal area and canopy cover (table 5). Data collected by the Grand Canyon Fire Effects Team on the Range and Thompson prescribed fires, indicated no changes in the number of large (greater than 16 inch diameter at breast height) conifers, and 0 percent and 7 percent reduction in the average number of intermediate (6 – 16 inch diameter at breast height) conifers respectively (USDI 2012). Wildland fires burn in a mosaic, leaving some areas with little to no fire effects. Furthermore, by restoring stand conditions and beneficial fire regimes, the project would reduce the potential for high-severity wildfire, which is one of the primary threats to Mexican Spotted Owl habitat (USFWS 2012).

Table 5. Forest vegetation simulation models for before and after Proposed Action (thinning followed by prescribed burning after a one year rest) within the 358 acres of Mexican Spotted Owl critical habitat.

Type	Existing Condition (2014)	No Action 2018	No Action 2034	Proposed Action 2018	Proposed Action 2034
Basal Area (sq. ft. per acre)	184	198	239	191	155
Basal Area for saplings – 12" DBH (in percentage)	37	70	35	37	15
Basal Area for 12" – 24" DBH (in percentage)	29	71	38	37	45
Basal Area for >24" DBH (in percentage)	46	50	27	26	40
Trees per Acre (18" – 24" DBH)	14	15	19	15	18
Trees per Acre (greater than 24" DBH)	11	12	15	12	14
Snags (greater than 14' DBH)	3	2	3	9	3
Downed Woody Debris (tons per acre)	1	1	2	1	3
Canopy Cover (percentage)	70	67	71	56	50

DBH – diameter at breast height

Minimal effects to Mexican Spotted Owl designated critical habitat are expected from the project on the 358 acres of recovery habitat. By conducting understory thinning and prescribe fire operations, surface fuel loads and basal areas would be reduced, canopy base heights would be increased, large diameter trees would become more resistant to fire, and the growth of fire-resistant tree species such as pine and aspen would be promoted. Over the life of the project, tree stand density within the project area would be reduced by removing trees less than 12-inch diameter at breast height in the mixed conifer (a more desirable condition for the forest) (USDA FS 2014).

One of the goals of the Proposed Action is to improve habitat and retain key Mexican Spotted Owl Recovery habitat variables and critical habitat primary constituent elements. During prescribed burning treatments, as noted above, isolated or small-scale group torching fire behavior may occur, but this is not desired and would be avoided to the degree possible.

Determination

The project may affect but is not likely to adversely affect Mexican spotted owls, their habitat, and/or designated Critical Habitat**.** The amount of Mexican Spotted Owl Critical Habitat proposed to be treated is small (358 acres), amounting to less than 1 percent of suitable habitat on the North Kaibab Ranger District. The proposed activities within and surrounding Mexican Spotted Owl Critical Habitat would benefit Mexican Spotted Owl by reducing the potential for high-intensity crown fire. Per the requirements of section 7(a)(2) of the Endangered Species Act, the Forest Service consulted with U.S. Fish and Wildlife Service regarding the project. The U.S. Fish and Wildlife Service concurred with the determination above (U.S. Fish and Wildlife Service 2018).

Forest Service Sensitive Species

Table 6 shows the Region 3 Regional Forester's Sensitive Species that occur on the project area. All other species on the list do not occur on the North Kaibab Ranger District and would not be impacted by the proposed project.

Table 6. Forest Service sensitive species

Species	Habitat Description	Habitat in project boundary
Northern leopard frog *Rana pipiens*	Breeds in shallow, permanent bodies of water. Currently in refugia ponds in House Rock Valley.	No, no further analysis required.
Bald eagle *Haliaeetus leucocephalus*	Winter resident on North Kaibab Ranger District.	Yes
Northern goshawk *Accipter gentilis*	Ponderosa pine and mixed conifer forests on North Kaibab Ranger District.	Yes
American peregrine falcon *Falco peregrinus anatum*	Cliffs (foraging areas to be considered)	Yes
Kaibab fairy shrimp *Branchinecta kaibabensis*	Dry lakes and vernal pools	Yes
Spotted bat *Euderma maculatum*	Roosts in crevices in cliffs or under loose rocks, forages on North Kaibab Ranger District	Yes
Allen's lappet-browed bat *Idionycteris phyllotis*	Ponderosa pine, pinyon-juniper, roosts in caves and abandoned mineshafts, forage on North Kaibab Ranger District	Yes
Pale Townsend's big-eared bat *Corynorhinus townsendii pallescens*	Hibernates in caves where the temperature is 54 F or less but usually above freezing, forages on North Kaibab Ranger District	Yes
House Rock Valley chisel toothed kangaroo rat *Dipodomys microps leucotis*	Shrub dominated Great Basin desert scrub communities in House Rock Valley.	No, no further analysis required.

Bald Eagle

Direct and Indirect Effects - Alternative 1, No Action

Bald eagles would not be displaced by noise or smoke if no action were taken, except in the event of a wildfire. The area would be at an elevated risk for high-intensity wildfire, which would destroy sheltered wintering snags. The improved carrion availability to eagles would not occur if no action were taken, unless there was a large wildfire.

Direct and Indirect Effects - Alternative 2, Proposed Action

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

Bald eagles may benefit from increased availability of mule deer carrion, like California condors (see above).

Determination

Potential displacement associated with the project would be short-term and limited in frequency. The Proposed Action would not affect or cause a trend towards future listing of bald eagles or their habitat.

Northern Goshawk

Direct and Indirect Effects - Alternative 1, No Action

Goshawks would not be affected by prescribed fire or mechanical treatments under the no action alternative. The Forest Vegetation Simulator models indicate within ponderosa pine stands, basal area and stand density index would increase with no action (project vegetation report), resulting in a very high potential for disturbance as either wildfire or insect/disease outbreaks. The 2006 Warm Fire resulted in almost 12,000 acres of nearly 100 percent vegetation mortality within ponderosa pine forest (USDA Forest Service 2009), and complete loss of goshawk habitat.

Direct and Indirect Effects - Alternative 2, Proposed Action

The Proposed Action would improve forest health and sustainability by reducing the risk of stand replacing wildfire. Opening the canopy through thinning would allow additional moisture and sunlight to reach the forest floor promoting grass and forbs sprouting (Abella et al. 2006). In addition, new open areas create favorable conditions for remaining trees to expand their root system for nutrient and moisture intake. This reduces the stress on the clumps and groups of trees enabling them to grow faster and be more resistant to fire, disease and drought. Finally, the Proposed Action provides space needed for seedling tree regeneration allowing for increased diversity of the herbaceous under-story and providing for more of a mosaic of age and structural classes that provide functional habitat conditions for a broad spectrum of wildlife species, including goshawk prey species.

Prior to mechanical treatments, goshawk nest surveys would occur, and if an active nest were detected, potentially disturbing activities would not occur within 300 yards from March 1 through September 30. There are potential direct effects from prescribed burning that could affect nesting and feeding behavior. Goshawk may be flushed from nest sites and/or change foraging behavior due to smoke accumulation. However, over the years as many as seven territories or nest areas under-burned during the breeding season (eggs or young in nest), and in only one of these cases did the nest attempt fail. The one nest failure may have been due to significant period of rain as many other active nests without fire also failed during this time (Reynolds et. al. 2017).

Prescribed burning or mechanical treatment activities may affect goshawks by changing their habitat structure (snags, downed logs, woody debris, vegetative structural stages, and dense canopy cover). Currently, the project area is sufficient in coarse woody debris, approximately 2 snags per acre, 3 downed logs per acre and 9 to 10 tons per acre of downed woody material. Prescribed fire may consume some snags and woody debris but would also produce these habitat features. Mechanical treatment would retain snags in accordance with forest plan guidelines. Effects to nesting area habitat would be reduced by retaining large trees greater than 14-inch diameter at breast height. Activities may change the structure of goshawk prey species' habitat, affecting the abundance and composition of prey species. Although treatments may have adverse effects to prey species and their habitat in the short term, returning forest structure to a fire adaptive ecosystem would increase habitat diversity, resulting in a more robust prey assemblage for goshawks in the long term (Reynolds et. al. 2013).

Determination

The retention of large trees greater than 14-inch diameter at breast height within nesting areas and nest surveys prior to mechanical treatment would mitigate effects to nest areas and active nests. The proposed treatment would create a fire-resilient mosaic benefitting goshawk prey species. The Proposed Action may temporarily impact individuals but would not cause a trend towards future listing for the northern goshawk.

American Peregrine Falcon

Direct and Indirect Effects - Alternative 1, No Action

If the no action alternative were chosen, peregrine falcons would not be temporarily displaced by noise or smoke while foraging. They would not benefit from the proposed mosaic of forest stand conditions, and the associated increase in diversity of prey species. No action would lead to increased probability of high-intensity wildfire like the 2006 Warm Fire, which is likely to be preferred foraging habitat compared to dense ponderosa pine forest.

Direct and Indirect Effects - Alternative 2, Proposed Action

There is no known nesting habitat within the project area; however, the known Oquer Canyon eyrie is located approximately ½ mile from the eastern edge of the project boundary. Noise impacts to the eyrie would not occur as no potentially disturbing project activities would occur within 300 yards of an active nest, per forest plan guidelines. Foraging habitat occurs in the project area. The Proposed Action would result in a more diverse vegetative structure, providing for an increase in diversity of bird and other prey species. Direct effects to the peregrine falcon could result from temporary displacement of any foraging individuals during treatment activities. Effects would be minimal, as the birds forage over vast areas. Peregrine falcons in Colorado apparently obtained prey in widely separated places with no apparent dependence on any certain area (Enderson and Craig 1997).

Determination

The Proposed Action does not affect nesting habitat. Individuals may be temporarily displaced by noise or smoke while foraging but would not cause a trend towards future listing for peregrine falcon.

Kaibab Fairy Shrimp

Direct and Indirect Effects - Alternative 1, No Action

If the no action alternative were chosen, the project area would experience elevated risk for high-intensity wildfire. Natural waters may be significantly impacted from runoff in the event of a large high-intensity wildfire.

Direct and Indirect Effects - Alternative 2, Proposed Action

Although fairy shrimp have not been found in the project area, potential habitat (such as snowmelt pools, sinkholes, and ponds) does occur there. According to Belk (1977), the two main factors that could impact fairy shrimp are salinity and seasonal variation of water levels in ponds. The Proposed Action has mitigation measures and best management practices specifically for soil and watersheds along with forest plan management of natural waters that would decrease the potential for unnatural change of salinity and water level within the natural waters in the project area.

Determination

The Proposed Action would not cause a trend toward future listing of Kaibab fairy shrimp. Soil and watershed best management practices during mechanical thinning and fire management would mitigate effects to natural waters.

Bats (Spotted, Allen's Lappet-Browed and Pale Townsend's Big-eared)

Direct and Indirect Effects - Alternative 1, No Action

Bats would not be impacted by loss of snags and short-term prey reductions if no action were taken, except in the event of a large high-intensity wildfire. Foraging bats would not benefit from the proposed increase in open forest conditions and associated prey availability. No action would result in increased probability of high-intensity wildfire similar to the 2006 Warm Fire. The Warm Fire, and similar early successional habitats, likely benefit foraging bat species. However, after the influx of snags created during the crown fire have lost their bark, the area would not have suitable large roosting snags for a century or more.

Direct and Indirect Effects - Alternative 2, Proposed Action

Direct effects to bats may occur due to snags being lost to fire, wind, or being felled for safety concerns during project activities. Prescribed burning and managed wildland fire would create new snags; however, they are typically smaller, and bats prefer large snags to use as roost sites (Chambers et. al. 2002). Snags would be maintained at 1-2 acres in accordance with forest plan desired conditions. Prescribed burning may result in a temporary loss of foraging habitat. Short-term indirect effects would result from vegetation modification activities such as thinning and broadcast burning.

These activities would disturb or remove understory vegetation, in effect reducing availability to insects. However, Waltz and Covington (2004) found a marked increase in butterfly (lepidopteron), the main prey species of Pale Townsend's big-eared bat in thinned and burned areas. Overall benefits in treatment areas would occur due to the reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor for the Proposed Action alternative. The resulting groups of trees interspersed with openings and interspaces would encourage the development of understory vegetation, increasing availability of food for these species over the long-term. Furthermore Abella et al. (2006) found that understory biomass can be greater than 10 times higher in remnant and restored openings.

Determination

The Proposed Action would not cause a trend towards future listing of the three forest sensitive bat species. It may result in short-term reduction in prey and some loss of large snags but have long-term benefits due to enhanced prey populations associated with herbaceous vegetation.

Rare and Narrow Endemic Species for the Kaibab National Forest

The forest plan (USDA 2014) provides desired conditions and guideline for the protection of rare and endemic species on the forest. Table 7 shows which terrestrial species are considered rare and endemic on the forest and whether they are located within the project area. Forest plan direction suggests project design should protect and provide for rare and narrow endemic species where they are likely to occur. For species not located within the analysis area, no further documentation is required within this analysis.

Table 7. Forest planning species classified as having restricted distributions or narrow endemic species

Species	Rare	Narrow Endemic	Species or Habitat in Project Area	Comments
Arizona black rattlesnake *Crotalus cerberus*	Yes	No	No	Found on south side of Grand Canyon
Utah Mountain kingsnake *Lampropeltis pyromelana infralabialis*	Yes	No	Habitat	Not detected on North Kaibab Ranger District but in Utah, they have been found in sagebrush, ponderosa pine and Douglas fir
Persephone's darner *Aeshna persephone*	Yes	No	No	Riparian habitat required
Kaibab fairy shrimp *Branchinecta kaibabensis*	No	Yes	Habitat	Is covered in Sensitive Species section
Kaibab variable tiger beetle *Cylindera terricola kaibabensis*	No	Yes	No	Only found on south end of the District (Stevens and Ledbetter 2012)
Kaibab Indra swallowtail *Papilio indra kaibabensis*	No	Yes	No	Likely range in North Kaibab Ranger District is the southern and eastern boundary areas, along and below canyon rims (Stevens and Ledbetter 2012).
House Rock Valley chisel-toothed kangaroo rat *Dipodomys microps leucotis*is	No	Yes	No	Only found in House Rock Valley
Kaibab least chipmunk *Neotamias minimus consobrinus*	No	Yes	Habitat	Associated with high elevation spruce-fir forests
Kaibab northern pocket gopher *Thomomys talpoides kaibabensis*	No	Yes	No	Only associated with meadows on the District (Bergamini et al. 2014)

Utah Mountain Kingsnake

Direct and Indirect Effects – Alternative 1, No Action

Due to the limited knowledge regarding this subspecies, it is difficult to assess the impact of no action. However, if a large high-intensity wildfire was to occur, it is likely this subspecies would be negatively impacted, at least in the short-term, due to lack of prey and/or direct mortality from fire.

Direct and Indirect Effects – Alternative 2, Proposed Action

It is unknown if this subspecies is sensitive to clearing, thinning or prescribed fire (Bergamini et al. 2014). The most likely habitat is rocky areas associated with steep slopes on the west and east sides of the project area. Mechanical thinning would not be conducted on slopes 40 percent or greater, except by low-ground pressure equipment in association with wildland fire preparations. Another potential habitat is brush or burn piles, and snakes may be affected by burning activities. However, piles are typically burned when snow is on the ground, when snakes are likely hibernating.

Determination

The Proposed Action would not cause a trend toward future listing of the Utah Mountain Kingsnake. It is unknown if this subspecies occurs in the project area or on the North Kaibab Ranger District, and the most suitable habitat would not be treated with mechanical thinning.

Kaibab Least Chipmunk

Direct and Indirect Effects – Alternative 1, No Action

Due to the small amount of potential habitat within the project area, the effects of the no action alternative would be similar to the Proposed Action except for the increased likelihood of high-intensity wildfire associated with no action, which may adversely affect this subspecies by eliminating its habitat.

Direct and Indirect Effects – Alternative 2, Proposed Action

The Fire or mechanical thinning may result in mortality of individuals. However, the thinning and wildland fire associated with the project are an attempt to restore historic fire and stand conditions and would likely benefit this subspecies overall (Bergamini et al. 2014).

Determination

The Proposed Action would not cause a trend toward future listing of the Kaibab Least Chipmunk. A small amount of mixed conifer habitat exists in the project area (approximately 360 acres), thus impacts to habitat would be negligible. Overall, this subspecies would benefit from reduced probability of high-intensity wildfire.

Migratory Birds

Direct and Indirect Effects – Alternative 1, No Action

The no action alternative would result in increased likelihood of high-intensity crown fire, similar to the 2006 Warm Fire or the 1996 Bridger Knoll Fire. Those fires have resulted in enhanced habitat for some species of migratory birds. Some bird species favor early successional habitat (Swanson et al. 2011). For example, the purple martin likely benefited from these fires due to their preference for open areas with snags. However, considering the increased likelihood of large fires in the southwest due to climate change, and that fires mentioned above have already created large areas of early successional habitat, it is important that mature ponderosa and pinyon juniper habitat be preserved on the district to ensure a mosaic of habitats is available for a wide diversity of migratory bird species.

Direct and Indirect Effects – Alternative 2, Proposed Action

Project implementation activities would provide a risk of incidental mortality of birds due to the use of heavy equipment and running over or into nests, felling of trees during thinning, and prescribed burning. These activities could cause the loss of eggs or nestlings. The level of incidental mortality caused by project implementation activities would be proportional to how many acres are treated during the spring nesting season of April, May, June, and July. Seasonal restrictions would limit project implementation activities between March 1 and September 30 in active goshawk nest areas, which would reduce potential of mortality for species listed in ponderosa pine habitat.

Mechanical treatment would occur minimally within pinyon-juniper habitat. Most of the prescribed burning on the North Kaibab Ranger District occurs after nesting season. Implementation would result in some level of incidental mortality (unintentional take) of some birds. Only a small percentage of habitats would be treated at any one time, particularly when considering the extent of these habitats forest-wide.

Therefore, the removal of any eggs or fledglings would not result in a measurable negative effect to the bird populations listed.

The project would modify migratory bird habitat. On the Kaibab and Coconino National Forests, Kalie and Rosenstock (2013) found that reduced canopy cover, increased density of large trees, and the presence of oak benefitted most species within ponderosa pine forest. The desired conditions for the project would reduce canopy cover in some areas, stimulate oak regeneration, and large trees (greater than 18-inch diameter at breast height) would make up the majority of basal area. Hurteau et al. (2008) recommend that forest management strive for a mosaic of forest conditions, in consideration of the varied responses that different species of passerines have to different treatments. A variety of treatment types, including Mexican Spotted Owl recovery habitat, goshawk nest areas, steep slopes, gradients in fire intensity, and fire-only areas would create a mosaic of bird habitats within the project area.

Determination

The Proposed Action may result in the incidental mortality of nesting birds and/or disturbance of individual birds in the short-term. In the long-term, proposed activities would help create a mosaic of migratory bird habitats and help preserve mature forest habitat types by mitigating the risk of high-intensity wildfires.

Specially Designated Areas

Grand Canyon Game Preserve

Direct and Indirect Effects – Alternative 1, No Action

The no action alternative would likely result in increased concealment cover, but diminished forage availability due to increasing canopy density. These conditions are not sustainable and would eventually lead to high-intensity wildfire similar to the 2006 Warm Fire and 1996 Bridger Knoll Fire. Mule deer have benefitted from these fires due to increased forage opportunities, particularly where mid-story and upper story vegetation species have recovered. Turkeys rely on large roosting trees, so large areas of crown fire would reduce habitat suitability for this species.

Direct and Indirect Effects – Alternative 2, Proposed Action

Thinning and wildland fire may result in short term adverse effects to individual game animals but would not threaten populations. By restoring the fire regime and stand conditions of the project area, game species may benefit due to greater amounts of aspen, oak, and understory herbaceous vegetation. Germaine et al. (2004) found that similar forest treatments, at nearby Mount Trumbull, resulted in reduced availability of concealment cover but greater availability of foraging microhabitat. Similarly, Wakeling et al. (1998) found that turkey nest sites had greater horizontal cover than surrounding ponderosa pine forest in north-central Arizona. The mosaic of different treatment types proposed would improve forage conditions for game species, while retaining denser areas necessary for cover.

Determination

The Proposed Action would not threaten populations of game animals. It would enhance herbaceous vegetation while maintaining areas for concealment. The conditions have been satisfied by assuring habitat conditions for these species are conserved.

Kaibab Squirrel National Natural Landmark

Direct and Indirect Effects – Alternative 1, No Action

Squirrels would not be impacted by mechanical treatment or fire, expect in the event of a wildfire. The no action alternative would increase the potential for high-severity wildlife, which would eliminate tree squirrel habitat.

Direct and Indirect Effects – Alternative 2, Proposed Action

Mechanical treatments and wildland fire may directly affect Kaibab squirrels with potential for mortality and/or disturbance associated with mechanical treatments and wildland fire. Kaibab squirrels may also be affected by alterations of its habitat. Patton et al. (1985) recommended leaving groups of trees around nest trees, feed trees, and water sources. Loberger et al. (2011) recommended leaving dense patches of trees with canopy cover 51-75 percent. The vegetation management efforts focus on returning the ponderosa pine forest to conditions that more closely resemble pre-settlement conditions. The Proposed Action would establish clumps and groups in a fashion that forms a mosaic at the fine and midscale, with some continuous areas of interlocking crowns.

Determination

The Proposed Action would have no long-term adverse effects on the habitat or population of Kaibab squirrel. The conditions of the Kaibab Squirrel National Natural Landmark have been satisfied by the design and provisions of this project to provide protection for the squirrel and its habitat by assuring habitat conditions continue for reproduction as provided by the Secretary of the Interior.

Cumulative Effects- Alternative 2, Proposed Action

Table 8 provides a summary of past, present, and reasonably foreseeable projects considered in this cumulative effects analysis.

Table 8. Cumulative actions table for past, present and reasonably foreseeable future actions

Project Name	Project Type and year	Acres (Approx.)	Project Description
Mechanical Treatment			
Jacob Ryan Vegetation Management Project	Mechanical treatment 2012 - Present	12,000 acres ponderosa	Commercial/non-commercial mechanical treatment based on northern goshawk habitat strata of ponderosa pine.
Moquitch Wildlife Habitat Improvement	Thinning 2011	500 acres ponderosa	Thin ponderosa pine up to 12” DBH
PFFPP Big Saddle Thinning	Thinning 2018	600 acres ponderosa	Thin ponderosa pine from 2-9” DBH.
Managed and Rx Fire			
Burnt Complex	Managed fire 2015	3,900 acres ponderosa	Wildland fire managed for resource benefit. Fire was managed to thin fuels in the area. The Burnt Complex occurred in the southern portion of the project area within ponderosa pine forest.
Moquitch Wildlife Habitat Improvement	Managed and Rx fire 2011-Present	9,500 acres ponderosa	Implement managed and Rx fire.
Jacob Ryan Vegetation Management Project	Managed and Rx fire 2012 - Present	25,000 acres ponderosa	Implement managed and Rx fire.

Project Name	Project Type and year	Acres (Approx.)	Project Description
Kaibab Plateau Ecosystem Restoration Project (KPERP)	Non-commercial thinning, managed fire, and Rx fire. Implementation in 2020	440,000 acres (all forest types)	Implement managed, Rx fire, and non-commercial thinning throughout the entire forest, excluding the wilderness areas and the project.

DBH-diameter at breast height

The following sections describe overall cumulative effects to wildlife. Table 9 summarizes species-specific cumulative effects.

Mechanical Treatment

Due to the limited amount of infrastructure on the North Kaibab Ranger District, the PFFPP project is limited in size and effects. Mechanical treatments during Moquitch were also limited in size and restricted to thinning smaller trees. The treatment effects to the species from Jacob Ryan are very similar to the species direct and indirect effects. Although the project would follow the desired conditions from an updated version of the forest plan, compared to Jacob Ryan, both projects seek to restore the uneven-aged stand conditions and frequent-fire regime of ponderosa pine forests. In addition, both projects have multiple treatment types resulting in a mosaic of habitat conditions and seek to protect snags.

Cumulative effects associated with mechanical treatment for projects listed above occur on approximately 28,000 acres, which is less than one fifth of the ponderosa pine forest on the North Kaibab Ranger District. Furthermore, treatments have occurred and are planned for only a portion of the 28,000 at a time. Short-term treatment effects, such as mortality and disturbance from noise and smoke would only occur during, or soon after treatments. Considering this, cumulative short-term effects would not negatively affect wildlife species analyzed for this project. Cumulatively, many species, as discussed above, would benefit from more open forest conditions and associated increase in herbaceous vegetation. The project in the cumulative effects area would reduce the potential for high-intensity wildfire within ponderosa pine, ensuring this forest type is available to wildlife species.

Managed and Rx Fire

The cumulative effects of managed fire and prescribed fire in ponderosa pine (Burnt Complex, Jacob Ryan, and Kaibab Plateau Ecological Restoration Project) would be very similar to those resulting from the wildland fire proposed in this project. A frequent fire interval of 0-35 years is the desired condition for ponderosa pine (USDA 2014). This project would strive to meet this desired condition for all ponderosa pine, except where other conditions conflict with this goal (such as wildland-urban interface).

Table 9. Summary of cumulative effects to species for which direct and indirect effects were analyzed

Species	Status	Cumulative Effects
California condor	Experimental population, non-essential	Due to proposed and ongoing mitigation measures, because nesting areas do not occur within North Kaibab Ranger District ponderosa pine, and the wide foraging range of this species, cumulative effects would be minimal. Condor may benefit from enhanced availability of carrion associated with desired forest conditions.
Mexican spotted owl	Threatened	North Kaibab Ranger District ponderosa pine forest is not Critical Habitat for this species. Therefore, cumulative effects are minimal.
Bald eagle	Sensitive	Desired conditions of 1-2 large (18-inch diameter at breast height minimum) per acre, particularly in sheltered areas, would ensure winter roosting habitat for the bald eagles. The North Kaibab Ranger District does not have any nesting habitat. Cumulative effects would not affect the regional distribution of this species.
Northern goshawk	Sensitive	Measures to protect active nests and nesting areas (see above) would ensure that life history needs are met in treated areas. Species benefits from efforts to mitigate the risk of high-intensity wildfire, which have eliminated large areas of northern goshawk habitat on the North Kaibab Ranger District.
American peregrine falcon	Sensitive	No cumulative effects to nesting habitat or regional distribution of this species. Peregrine falcons benefit from more open forest conditions resulting from treatments due to enhanced foraging opportunities.
Kaibab fairy shrimp	Sensitive	Soil and watershed mitigation measures for past, present, and reasonably foreseeable projects minimize negative effects associated with erosion.
Spotted bat	Sensitive	Species may benefit from openings created during treatments due to enhanced insect abundance. No cumulative affects to hibernating, breeding, or roosting habitat.
Allen's lappet-browed bat	Sensitive	Desired conditions of 1-2 large (18-inch diameter at breast height minimum) per acre would reduce negative cumulative effects to breeding and roosting habitat. Species may benefit from openings created during treatments due to enhanced insect abundance.
Pale Townsend's big-eared bat	Sensitive	Species may benefit from opening created during treatments due to enhanced insect abundance. No cumulative affects to hibernating, breeding, or roosting habitat.
Utah mountain Kingsnake	Rare and Narrow	Limited habitat and no detections for this subspecies on the North Kaibab Ranger District. Steep rocky areas most likely habitat, which receive no mechanical treatment. Cumulative effects would not affect distribution of this subspecies.
Kaibab least chipmunk	Rare and Narrow	Ponderosa pine forests in northern Arizona are not suitable habitat for this subspecies. Therefore, cumulative effects are minimal.
Migratory birds	MBTA	Mosaic of habitat conditions achieved through a variety of mechanical treatment and managed wildland fire. Early-successional habitats available due to high-intensity wildfire. Treatments reduce potential for high-intensity fire; ensuring mature ponderosa pine forest is available for migratory birds. Cumulative effects would not affect distribution of migratory bird species.
Game species	GCGP	Mule deer and turkeys benefit from cumulative effects associated with open forest conditions and associated enhanced herbaceous forage. The mosaic of conditions derived from multiple treatment types, including fire, reduce negative effects associated with reduction in cover.
Kaibab squirrel	NNL	Treatments with uneven-aged management with groups of trees with interlocking crowns, with some large trees, have and would minimize cumulative effects to Kaibab squirrel habitat.

Scenery & Recreation (See "Scenery & Recreation Specialist Report," USDA Dec. 10, 2019b)

Spatial and Temporal Context for Effects Analysis

The varied recreation in the project area is often dictated by season and weather. The entire project area falls into the Roaded Natural (RN) RON class guidelines.[11] Within the RN class, carefully managed landscapes maintain or enhance recreation and scenic values, sites and features. These RN areas are managed to be natural appearing, and changes to natural vegetation patterns may be evident but are in harmony with the natural setting.

The entire project area also falls into the class scenery integrity objective 3, moderate (slightly altered).

Environmental Effects

Direct and Indirect Effects - Alternative 1, No Action

Visually, where recreation is prevalent, there has not been large-scale manipulation or influence on the scenic value. The recreation opportunity spectrum class and scenery integrity objective level indicate the desired conditions for the Kaibab National Forest landscape. The existing recreation opportunity spectrum and scenery integrity objective may not currently meet these desired conditions. The Burnt Corral project is designed to maintain or improve these to meet the desired conditions. Proposed thinning and prescribed burning treatments would not occur under the no action alternative. Therefore, the existing condition would remain, and recreation opportunity spectrum of Roaded Natural and SMS rating of level 3-moderate would persist.

Any direct and indirect effects of the no-action alternative on the recreation resource would be due to increased tree density within the project area resulting in the continuation of the fuel loading and decrease in forest health.

Cumulative Effects- Alternative 1, No Action

The increased likelihood and severity of wildfires would affect the recreation experience in the areas they occur for a considerable length of time and could include closures, restrictions, loss of recreation opportunities. Conditions could deviate in the long term from recreation opportunity spectrum zone desired conditions.

Direct and Indirect Effects - Alternative 2, Proposed Action

The proposed activities would affect the foreground (within ¼ -½ mile of the viewer) landscape. Visitors would be affected by the treatments, as they take place, as well as by the blackening of the landscape, from surface and understory burning, would be visible. Effects at these proposed sites would have short-term effects and after new growth occurs, permittees and visitors would not notice the treatments.

The Burnt Corral proposal would have short-term effects to recreation opportunities and possibly long-term effects to scenery. These effects include a disruption to visitor use while the treatments are occurring; from smoke, equipment noise, road access, and scenic value, as well as the longer-term visual effects such as charring, tree mortality, and the presence of constructed piles that might disrupt a visitor's experience.

[11] Kaibab National Forest Recreation Opportunity Spectrum and Scenery Management System Guidebook (2014).

Cumulative Effects- Alternative 2, Proposed Action

The scenery integrity objective level would be degraded for a short period from moderate to low-moderate. This action is acceptable to accomplish large-scale restoration where the outcome in the future is for an improved scenery integrity objective overall by restoring the landscape to desired conditions.

Weeds and Botany (See "Non-Native and Invasive Plant Species Specialist Report," USDA Feb. 2017a; and "Botany Report, USDA Feb. 2017)

Spatial and Temporal Context for Effects Analysis

There is only one federally listed plant species on the North Kaibab Ranger District. The Fickeisen plains cactus (Pediocactus peeblesianus var. fickeiseniae) was listed as endangered on October 31, 2013. This species and its designated critical habitat on the only occur on the rim of South Canyon and is not within or adjacent to the project area, and would not be impacted by the project.

Eighteen plant species on the USDA R3 Regional Forester's Sensitive Species 2013 list occur on the Kaibab National Forest, and shows the species that either occur or have habitat in the project area. North Kaibab Ranger District. All other species on the Forest list do not occur on the North Kaibab Ranger District and would not be impacted by the project.

Table 10. Sensitive species for the Kaibab National Forest that could or do occur within the Burnt Corral project boundary

Species	Comments	Species or Habitat in Project Area?
Mt. Dellenbaugh sandwort *Arenaria aberrans*	Rocky habitats of ridges and canyon rims in oak and pine forests but also found in pinyon and juniper, 5500 – 9000 ft., South, north, and northeast aspects, sandy soil in Coconino County.	**Habitat**
Arizona (clustered) leatherflower *Clematis hirsutissima var. hirsutissima*	Rocky hillsides in open to dense ponderosa pine with slopes from 12% to 40% and aspects from 320° to 40°, 7000-8500 ft., limestone soils with few populations on basalt, Known populations on North Kaibab Ranger District	**Habitat**
Arizona phlox *Phlox amabilis*	Open, exposed limestone or basalt rocky slopes within pinyon-juniper and ponderosa pine/Gambel oak, Known populations on the North Rim of the Grand Canyon and Williams and Tusayan Ranger Districts	**Habitat**

Environmental Effects

Direct, Indirect and Cumulative Effects - Alternative 1, No Action

The no action alternative would result in a continued risk of high-intensity wildfire. Low to moderate fire can benefit sensitive species by reducing the depth of litter, without removing it entirely. However, high-intensity wildfire can remove litter entirely, resulting in reduced soil moisture and greater erosion. High intensity wildfires may also result in increased prevalence of invasive species, which have the capacity to alter ecosystems for the near future, and move the project area away from desired conditions described in the Kaibab Forest Plan.

Direct and Indirect Effects - Alternative 2, Proposed Action

Sensitive Plants

Direct effects from the Proposed Action includes loss of individual plants or population groups through management actions. Factors contributing to these effects include disturbance from management actions such as activities associated with tree removal and prescribed fire.

Mechanical treatments would provide structural diversity to promote suitable habitat for a host of understory species with differing resource requirements (shade-tolerant vs. shade-intolerant), and may increase the abundance of sensitive plant species. For example, Mt. Dellenbaugh sandwort prefers forest openings; therefore, reductions in tree densities would favor this species.

Changes in the amount of sunlight available for plants could have positive or negative effects to sensitive species depending on the amount of change produced by management actions. A study on leatherflower, Maschinski et al, (1997) found that high levels of light may lead to increased vegetative growth, but lower reproduction and seedling survival. Given that these species evolved in a fire-adapted ecosystem, it is unlikely that prescribed fire of low to moderate intensities would negatively affect species viability.

Deep litter may negatively affect the plants but removal of all litter from the site would have adverse effects on juvenile plants, these effects would be mitigated by burning under conditions that would reduce the litter layer without removing it entirely. Long-term effects include the loss of shade from tree mortality or reduction in the amount of litter that would be detrimental to juvenile plants, which need some litter to retain moisture around them. This would be mitigated by managing burning at intensities low enough to limit mortality to trees and preserve a light layer of litter.

Prescribed fire has the potential to expand the current abundance and distribution of sensitive plant species by enhancing structural (variable shading) and functional (nutrient flow) ecosystem properties.

An indirect effect from proposed activities includes an increased risk of invasion from noxious or invasive weeds. These effects would be mitigated by incorporating the best management practices described in of Final Environmental Impact Statement for the Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab and Prescott National Forests (2005).

Rare and Narrow Endemic Species

The Proposed Action may affect individuals of rare or endemic plant species (table 11), but it would have no measurable negative impact on the population because of their limited occurrences within the project area, and the implementation of mitigation measures listed below that are designed to protect known and newly discovered populations.

Table 11. Rare and narrow endemic species for the Kaibab National Forest that could or do occur within the Burnt Corral project boundary

Species	Habitat	Species or Habitat in project area?
Colorado blue columbine *Aquilegia caerulea var. pinetorum*	Rare – aspen with mesic mixed conifer and spruce fir and seeps, 5700-9000 ft	Habitat
Groundcover milkwetch *Astragalus humistratus var. tenerrimus*	Endemic – ponderosa pine and spruce fir, limestone-derived soils, 7800-8700 ft, locally abundant with large populations south of Jacob Lake and has been found south of the Grand Canyon and Flagstaff	Habitat
Silver milkvetch *Astragalus subcinereus*	Rare – open meadows and beneath trees in ponderosa pine, white fir, pinyon-juniper, aspen, and sagebrush, level terrain and slopes, 1400-2700 m, Known locations throughout North Kaibab Ranger District and south of Tusayan	Habitat
Wright's bird's-beak *Cordylanthus wrightii spp. Kaibabensis*	Rare – pinyon-juniper, ponderosa pine, and sagebrush, 7220 ft, limestone with grass and shrubs, Found on North Kaibab Ranger District	Habitat
Arizona bladderpod *Lesquerella arizonica*	Rare- sandy and gravelly soils, limey knolls or limestone chip, open stands of sagebrush-pinyon, pinyon-juniper, Gambel oak, and sometimes ponderosa pine, 3200-7200 ft	Habitat
Macdougal's bluebells *Mertensia macdougalii*	Rare – montane willow riparian forest and ponderosa pine, variety of substrates, 6000-9000 ft, Known sites on rims of the Grand Canyon and Bill Williams Mountain	Habitat
Kaibab beardtongue *Penstemon pseudoputus*	Endemic – ponderosa pine and montane supalpine grassland, limestone, basalt and sandstone, 6560-9500 ft, Found on North Kaibab Ranger District	Habitat and Species
Bearded cinquefoil *Potentilla crinite var lemmonii*	Endemic – ponderosa pine, 6800-8000, limestone and volcanic-derived soils, North Rim of Grand Canyon to Flagstaff	Habitat
Oregon buttercup *Ranunculus oreogenes*	Rare – ponderosa pine, 6000-8500, limestone, sand, and basalt, Known locations on the North Kaibab Ranger District and Tusayan	Habitat

Determination

Mechanical treatments and prescribed fire may affect sensitive plant species individuals but is not likely to contribute to a trend toward federal listing or a loss of sensitive species viability because of their relatively limited occurrence or absence within the project area and the implementation of mitigation measures.

Cumulative Effects- Alternative 2, Proposed Action

The cumulative impacts that could affect sensitive and rare and endemic plants across the Burnt Corral Project Area over the next ten years include climate change, wildfires, invasive species, and travel management.

Climate Change

Climate change could affect the distribution of vegetation in general by affecting biotic and abiotic factors and by increasing the extent and severity of disturbances (Peterson et.al, 2011). Rare and sensitive species may be especially vulnerable because they often need specific habitat components such as specialized soil types that are not widely available. This could negatively affect their abilities to migrate to suitable areas as environmental conditions change. Climate change coupled with other factors such as habitat loss could lead to extirpations and increased risks of extinction. Species generally respond to rapid climate change at differential rates. These differential movements may lead to loss of connectedness and loss of communities (Root et al, 2003). While the activities of this project would not mitigate widespread climate change, actions would provide more resiliency to our local vegetative communities, restore natural fire regimes and reduce the risk of habitat loss due to uncontrolled wildfire.

Fire

Years of fire suppression combined with climate change has led to an increasing number of high intensity wildfires in recent years. While fire historically played a key role in maintaining healthy ecosystem function, high intensity wildfires can dramatically alter an ecosystem by damaging or destroying plants and any potential seed in the soil. The disturbance created by these events leave burned areas lacking native seed in the soil and open the door for new species to become established. This includes non-native invasive species that can rapidly establish and dominate a site within a few years after a fire.

Restoring forests to fire adapted ecosystems will be an ongoing effort for the foreseeable future. Managed fires in conjunction with mechanical treatment can reduce heavy fuels, preventing catastrophic fires from occurring. When a fire occurs, the area is rested until the understory species have responded to the point being able to sustain grazing pressure. By reducing the potential for negative impacts to sensitive plant species and providing added rest options for the allotments, the long-term survival of many plant species is increased.

Non-native invasive species

Non-native invasive species continue to invade and establish on federal lands. These species are adapted to outcompete native species for nutrients and can rapidly establish and dominant sites. Invasive species pose a high risk to sensitive plant species and can displace them if left untreated. The implementation of noxious and invasive weed control efforts has reduced the number of exotic plant species within the North Kaibab Ranger District. The containment, control, and eradication of species like Scotch Thistle, Spotted Knapweed, and Cheatgrass is expected to continue for the foreseeable future. With these practices are guidelines for performing project activities that would reduce the risk of introduction of new invasive species and prevent the spread of undetected existing populations.

Travel Management

The Kaibab National Forest implemented the Travel Management Rule in 2013. The cumulative effects to rare, sensitive, and other species are the reduction in the numbers of motorized routes and the elimination of cross-country travel. Negative effects from motorized vehicles such as crushing of plants, damage to potential habitat such damage to soils, fragmentation of habitat and introduction of noxious or invasive weeds into the habitats and/or populations have been reduced. These reductions would be from the elimination of most cross-country travel and through the reduction of road density.

Range (See "Range Specialist Report," USDA Oct. 2019)

Spatial and Temporal Context for Effects Analysis

The Burnt Corral project areas is located within portions of the Central Summer and Central Winter grazing allotments. The portion of the project area that includes the Central Summer allotment is grazed every other year by 600 to 1,000 head of cattle. Although grazing is permitted in the Central Winter Allotment, it is not currently being grazed, and grazing in this allotment could begin when structural improvements are repaired to standard and research shows that grazing can be initiated without undue risk of spreading invasive weeds.

Environmental Effects

Direct and Indirect Effects - Alternative 1, No Action

Implementation of the no action alternative would eliminate the short-term (zero to three years post treatment) effects of the Proposed Action (disruption of planned grazing management activities) and allow livestock grazing to continue uninterrupted by the proposed burning activities and time needed for herbaceous vegetation to reestablish in the project area. However, the No Action alternative would continue the current risk of high intensity wildfire that is expected to impose an even more substantial disruption, both short and long term (15 to 20 years or more), to livestock grazing and forage production on the North Kaibab. This disruption would be due to the loss of structural range improvements (fences, corrals, water developments) and the reduced production of palatable forage that would likely result from high intensity fire followed by soil erosion and the invasion of non-desirable invasive plants.

Cumulative Effects- Alternative 1, No Action

The cumulative effects for the no action alternative include continued risk of high intensity wildfire that would impose more substantial disruptions long term (20 years and more) to forage production.

Direct and Indirect Effects - Alternative 2, Proposed Action

The proposed management activities are expected to have some level of short-term (zero to five years post treatment) negative impact to forage production and livestock grazing within the project area. In the longer term, (five to twenty years post treatment) benefits to both forage production and increased options for livestock management are expected.

Fire

The short-term (zero to three years post treatment) effects of the proposed fuel treatments and activities of personnel and equipment are expected to decrease forage production and limit grazing opportunities within the burned and adjacent areas. The long-term effects of the proposed fuel treatments would be positive except for an increased risk of introduction and spreading of undesirable vegetation, particularly invasive weed species. Cheatgrass is a highly invasive species that could quickly become established in the project area, would increase the risk for future fires, and would decrease the amount and quality of forage that would be produced in the project area. Mitigation activities should be included with the proposed treatment activities to reduce the risk of invasive species spreading after prescribed fire.

The proposed fuels treatment would remove or reduce the density of overstory vegetation (trees and shrubs) and increase the amount of sunlight that can reach the forest floor. This increased sunlight and reduced competition for water and soil nutrients would favor herbaceous forage production for 15 to 20 years post treatment. This would provide additional forage for livestock and wildlife in areas where

forage production is currently low. The additional areas of herbaceous forage production would allow greater flexibility for grazing permittees and increase management options.

Perhaps the greatest benefit from the proposed fuel treatments would be the reduced risk of high intensity wildfire. The fires expected in this project would be low intensity, "cool" fires that would pose minimal loss of desirable soil components (biota, nutrients and structure). High intensity fires typically have longer lasting negative effects on soils, plant species composition, and forage production.

Mechanical Thinning

The short-term (zero to two years post treatment) effects of the proposed mechanical thinning treatments are expected to decrease forage production within the treatment areas where physical disturbance to soils and forage occurs. These activities and the reduced availability of forage may require alterations in established grazing patterns for permitted livestock and could require temporary fencing or additional herding to protect succulent regrowth from being grazed. Continuation of livestock grazing could occur within these areas once herbaceous vegetation has become sufficiently established to protect soils from erosion and invasion of undesirable plant species.

Range Structural Improvements

The planned thinning and burning activities would produce both positive and negative effects for the range structural improvements within the project area. Anticipated negative effects include direct physical damage caused by machinery or created breaches in fences where needed to provide access to vehicles and equipment; and unavoidable burning of wood posts and poles and heat damage to fence wire and metal T-posts. Soils exposed by mechanical disturbance or burning activities are also susceptible to erosion with possible sedimentation into stock ponds and cattle guards.

The most likely positive effects of the planned treatment activities for structural improvements include removal or thinning of dense shrub communities that currently hinder or prevent access for maintenance and reconstruction of fences and stock ponds, and removal of fencing material damaged in the Bridger Knoll fire. Removal of trees adjacent to existing allotment fences would also reduce the likelihood of trees falling across fences and the associated costs of maintaining and repairing damaged fences. The reduced likelihood of high intensity wildfire would also help prevent or lower the amount and degree of damage that is likely to occur to existing improvements.

Cumulative Effects- Alternative 2, Proposed Action

The cumulative effects boundary for this project is the area within the Central Summer and Central Winter grazing allotments, and up to 20 years into the future. The proposed activities (fire and mechanical treatments) have the potential to effect livestock production and range resources (herbaceous vegetation and range improvements) and both within and outside the project area. Anticipated effects include the spread of undesirable plant species into and out of the project area by natural dispersal mechanisms and through human activities that could carry seeds or vegetative propagules into or out of the project area.

The planned fuel treatments, both fire and mechanical, are expected to provide a reduced risk of high intensity wildfire within and outside the project area. The reduction of fuel loading inside the planning area would lessen the risk of fire from inside the area spreading to surrounding areas or other fires traveling though the project area and causing undesirable damage to range improvements, herbaceous vegetation (forage for livestock and wildlife) and soils.

The proposed thinning activities would also provide an economic benefit to grazing permittees by helping to maintain their options for livestock grazing and reducing the likelihood of costly alterations of grazing

plans and maintenance or reconstruction of range improvements both within and outside the planning area.

Roads (See "Transportation Report," USDA Nov. 2019a)

Spatial and Temporal Context for Effects Analysis

Within the Project boundary, about 24,600 acres are within ¼ mile of roads (162 miles +/-) that are designated for motorized use by the public as shown on the Motor Vehicle Use Map (MVUM). These roads are considered disturbed areas due to regular use. Performing upkeep or maintenance and/or hauling timber on these roads should have minimal impact due to existing conditions. General road maintenance is covered under a categorical exclusion 36 CFR § 220.6(d)4 for Forest System Roads. Activities that restore, rehabilitate, or stabilize lands (decommissioning or restore to a natural state) occupied by roads and trails is covered under a categorical exclusion 36 CFR § 220.6(2)19.

To access the 1,851 acres, approximately 40 miles of existing roads in storage (Maintenance Level 1) could be utilized or be opened for the duration and purposes of the project. These additional 40 miles of roads are only one third of the roads in storage within the project. When you combine the 40 miles of Maintenance Level 1 closed roads with the MVUM open roads (ML2, ML3), it would provide direct access to approximately 26,477.4 acres in the project area.

The remaining 1,610 acres may need additional temporary roads in order to implement thinning activities within those particular areas. However, the majority of these non-accessible acreages exist in the western portion of the project area where there are steep slopes and sensitive soils area, as well as the non-Ponderosa pine vegetation type such as Pinyon-Juniper, scrub oak, and New Mexico locust. (*Robinia neomexicana)*. Temporary roads would access the Ponderosa pine vegetation, not theses other lower lying areas made up of a different vegetation type.

Environmental Effects

Direct, Indirect, and Cumulative Effects - Alternative 1, No Action

There are no treatments or other activities would occur under the no action alternative. System roads used would see continued wear from regular use such as gravel loss, rutting, and potholing. There would be no addition or temporary road construction, therefore no direct, indirect or cumulative environmental consequences are anticipated, as related to temporary roads.

Direct and Indirect Effects - Alternative 2, Proposed Action

System roads used by motorized vehicles would see typical wearing such as gravel loss, rutting, and potholing. Normal traffic over time would create issues, as described; heavy haul vehicle typically would see a faster degradation of roads, especially in varying climate conditions. Rain and snow would reduce the strength of the road depending on saturation, and wind/sun would cause increasing blowing fine particles during heavy use. Based the most recent projects located on similar terrain such as the Jacob Ryan project and the Plateau Facility Fire protection project demonstrate addition or temporary road construction would most likely not be necessary, therefore, little-to-no effect or environmental consequence is anticipated, as related to temporary roads.

Many of the ML-2 and ML-1 roads are overgrown or have seen little maintenance, causing drainages to be blocked. Utilization of these roads would restore drainage to the road, and increase the integrity of the existing roads system as the roads are maintained for restoration efforts.

Construction of temporary roads is not anticipated for the Burnt Corral area; utilization of existing Forest Service roads that are currently closed would alleviate the need and avert temporary road construction. Construction of temporary roads releases settled earthen material that has stabilized in existing condition. During operations, temporary roads would see an increase in erosion or sediment transportation from inclement weather and wind driven dust. The decommissioning of the roads would see the roads ripped to loosen compacted material from hauling, and if necessary added water control features/mulch as stated in the best management practices. Continued erosion or sediment movements are would occur until vegetation from re-seeding is established, or until layers of pine, mulch or grass is re-established.

Cumulative Effects- Alternative 2, Proposed Action

The proposed activities would create an additional benefit for the roads in the cumulative effects boundary which is the project area and its access roads over the next 25 years or the duration of project implementation. Trees removed within or directly adjacent to system roads, they would become dryer (due to more sunshine and natural evaporation) and hold up to traffic for longer periods. Additionally, the main boundary roads that serve as hold points for designated burn blocks may act as a firebreak and have a higher potential of successfully restricting fire movement from crossing main roads/lines.

The vegetation treatment or restoration efforts would utilize heavy equipment and machinery on the road system. Large commercial vehicles would wear out the surface faster than typical passenger cars. Access routes to and from the project, area (surrounding areas along the haul routes) would experience increased surface degradation such as pot holing, soft spots, gullying due to loss of soil hardening. If traffic is diverted around activities, additional wear and tear may occur on areas that are adjacent to those restoration areas, depending upon the amount of traffic. Most roads within the interior of project boundary are roads that receive little use during the year. Additionally, most of the project area may be inaccessible during winter months when snow depths make the area impassible. Thus, use of roads in the area at elevations above 6000 feet, is usually limited to the months of April through November.

Economics (See "Socio-Economics & Environmental Justice Write-up," USDA Dec. 31, 2019e)

Spatial and Temporal Context for Effects Analysis

An economics summary profile report from Headwater Economics was generated utilizing Economics Profile System for the three local counties in this area (Coconino and Mohave Counties, Arizona, and Kane County, Utah). The potential for impacts to the local area would be the area known as the Arizona Strip, which is north of the Grand Canyon and south of the Utah boarder; Fredonia and Colorado City are the only two local communities in Arizona in that area. Page is some 60 miles to the east. Kane County Utah is situated along the Arizona border, is approximately 4,000 square miles, and has a population just over 7,000.

Environmental Effects

Direct and Indirect Effects - Alternative 1, No Action

Under the no-action alternative, there would be no thinning or prescribed burning. As a result, there would be no income generated from commercially sized wood to offset costs incurred from implementing non-commercial thinning and prescribed burning. The project area would remain at risk for a high intensity stand-replacing fire like the Warm Fire. High-intensity stand-replacing wildfires incur costs associated with suppression, post fire rehabilitation, and reforestation. The economic cost for suppressing such a fire runs high, usually at $1,000 to $2,500 per acre, posing a potential cost of $20 to $30 million for the project area (if such a high intensity wildfire were to occur within the Burnt Corral project area).

Post-fire rehabilitation, including emergency soil stabilization, seeding, and replanting, have high per-acre costs. Stand-replacing wildfires also cause losses to Forest resources (soils, timber, range permit fees), which can have economic effects in the form lost commercial related revenues, or from the reduction in tourism dollars, if available forested area used for camping and recreating is diminished. The no-action alternative would not meet the intent of the forest plan and moving forested areas of Ponderosa pine towards desired conditions; conditions or metrics, such as basal area, and stand density would continue to increase, as well as the risk of a catastrophic wildfire or deteriorating conditions such a beetle infested areas.

There would be no cumulative effects from selecting the no action alternative.

Direct and Indirect Effects - Alternative 2, Proposed Action

The Proposed Action would generate commercial timber, and the value of this timber may be sold or traded as "goods for services" or in a stewardship contract. Stewardship contracts are good or effective tools that may be used to offset the costs of activities associated with small tree thinning and controlled burning. Receipts from timber sales would help offset the cost associated with implementation of any noncommercial thinning and prescribed burns. Due to fluctuations in timber prices, it is difficult to project the discrete economic effects of the Proposed Action. Further, the current limited existence of operating mills near the project area makes it problematic to identify the specific locations where economic effects would be felt the strongest. There is currently one small mill (employing approximately 30 to 35 personnel) in operation in Fredonia, Arizona, and several others within a 200-mile radius of the project area.

Despite the challenge in identifying the specific quantity and location where social or economic effects would be felt the strongest, a project of this size and limited duration (up to 15 years) would have considerable direct, indirect, and induced effects on the local economy (Fredonia, Arizona, and possibly Kanab or Panguitch, Utah). Direct effects are the responses of an industry to demand for goods or services. Indirect effects occur when a sector must purchase supplies and services from other industries in order to produce output sufficient to meet demand. For example, the ancillary support businesses of running a timber mill would involve trucking, logging suppliers, sawmill suppliers, and other local supplies and services. The employment and labor income generated in other industries due to implementation of the Proposed Action are referred to as indirect effects.

Induced effects represent the employment and labor income stimulated throughout the local economy because of the expenditure of new household income generated by direct and indirect employment. Induced effects are often felt multiple times over as revenues are spent and re-spent in different sectors of the economy. For instance, going to the local clinic to see a doctor and paying a doctor or clinic bill; or purchase of local goods and services in the area where the employees reside, when working for the timber company involved in the Burnt Corral area thinning. Project timeline estimates to complete the project are between 10 to 15 years.

There would be about 5,000 board feet per acre of log volume directly produced from tree harvest. The sale of commercial timber would provide revenues to the Forest and help offset costs of timber stand improvement work, prescribed burning, and managed wildfires (USDA 2016 - Domis 2019, pg. 32). Non-commercial thinning and prescribed burning have costs associated with implementation, but much of the costs are in the form of wages, which would result in beneficial indirect and induced effects. Indirect and induced economic effects would also result from the sale of merchantable timber and processing of wood products. Wood processed at other locations other than Fredonia, Arizona could contribute to

stimulation of the local economy through purchases such as fuel, food, electricity, and supplies needed to transport and process the wood.

Cumulative Effects- Alternative 2, Proposed Action

The analysis area considered for economic effects is for Kane County, Utah and Coconino County, Arizona, although the effects could reach into Washington and Garfield Counties in Utah, and Mohave County, Arizona as well. Tourism, recreation, and service industries tied to tourism, are the main industries within the immediate analysis area and have been expanded over the last 15 years, which may help offset any decline in the wood products industry. The timeframe for potential economic benefit to these communities by implementing the Proposed Action is 10 to 15 years. Economic benefits reach beyond the salaries for those working the project, but also provide monetary infusions to the community in the form of rents, supplies (food/fuel) and related services. The project would provide an economic benefit to the communities; however, the effect would likely be small as the total contribution of Kaibab National Forest activities are estimated to be responsible for only about 0.5 percent of the jobs and labor income within the regional economy (USDA Forest Service, 2008). The economic effects of implementing the Burnt Corral Project would inject needed workforce funding into the local economies, and when added to other current and foreseeable future projects, would create a net beneficial effect to local county economies for years.

Heritage (See "Heritage Resources Specialist Report," USDA March 2018)

Spatial and Temporal Context for Effects Analysis

Cultural Resources are bound in time and space and heritages sites are stationary. Consequently, the cumulative effects boundary for this analysis is the project area. Project activities would be limited to the project area during the implementation period. Recommended actions to protect heritage resources from direct and indirect impacts during project implementation will minimize the potential to have an adverse effect on tribe cultural resources.

Environmental Effects

Direct and Indirect Effects - Alternative 1, No Action

Under the no action alternative, current and existing management plans would continue to guide the project area. Hand or machine felling or piling, prescribed burning, or pile burning would not occur. This alternative would retain the existing condition and have no direct effect on heritage resources. However, existing fuel loading could have an indirect effect on heritage sites in the event of catastrophic wildfire that frequently results in adverse effects to heritage resource sites.

Cumulative Effects- Alternative 1, No Action

There would be no adverse cumulative effects from ground disturbing activities to heritage resources from the No Action alternative because those activities would not occur within the analysis area. However, if existing fuels are not treated within the project area and within adjacent fuel reduction projects, the no action alternative could have adverse cumulative effects on heritage sites in the event of catastrophic wildfire, which frequently results in impacts to heritage resource sites.

Direct and Indirect Effects - Alternative 2, Proposed Action

The activities listed in the Proposed Action have the potential to directly impact heritage resource sites. Many of the techniques utilized during fuels treatments are potentially ground disturbing. In order to protect heritage resource sites, all sites have been identified and documented using cultural resource

survey standards as per the North Kaibab Survey Strategy (Reid and Hanson 2006). The standard survey procedures are designed to identify and document sites visible on the surface of the ground. If an undocumented site is unearthed during ground disturbing activities, implementation activities would cease and the North Zone archaeologist would be contacted to assess the remains and complete any legal consultation required.

All unevaluated heritage resource sites or sites eligible to the National Register of Historic Places would be avoided during the implementation of any ground disturbing activities. Prescribed burning would be permitted at non-fire sensitive sites. However, no piling of slash, pile burning or broadcast burning of slash would be authorized atop any sites. Hand thinning may occur at archaeological sites and architectural features identified for prescribed burning to reduce fuel loading if it is deemed necessary. However, Kaibab National Forest archaeologists would help direct hand thinning operations within site boundaries.

If the project design criteria are met and implemented, then the Proposed Action alternative should have no direct or indirect adverse effects to heritage resource sites. Reducing fuel loads around and within heritage sites would provide a beneficial effect to these resources in the event of a wildfire, by making them less susceptible to burning and subsequent disturbance of subsurface cultural deposits by tip-ups of burned trees, in the case of Puebloan structural sites within the Bridger-Knoll burn.

Cumulative Effects- Alternative 2, Proposed Action

Cultural Resources are bound in time and space. The cumulative effects boundary for this analysis is the project area. Project activities would be limited to the project area during the implementation period, and heritage sites are stationary. Actions to protect heritage resources from direct and indirect impacts from project implementation have been described in the above sections.

If the recommended mitigation design criteria measures were employed during project implementation, there would be no adverse cumulative effects to heritage resources from ground disturbing activities associated with the Proposed Action. Reducing fuel loads around and within heritage sites using the specified design criteria would provide a beneficial effect to these resources in the event of a wildfire, by making them less susceptible to adverse effects caused by burning.

Climate Change (See “Carbon Cycling/Storage and Climate Change Write-up,” USDA Dec. 16, 2019c)

Spatial and Temporal Context for Effects Analysis

Climate change is addressed throughout the forest plan, through desired conditions in the form of functional ecosystems and resilient landscapes, and directly in management approaches and the monitoring plan where appropriate. Climate change trending is generally measured in terms of changes over three decades to potentially reflect what direction (up, down or somewhat constant) certain climate factors are headed or trending towards.

Existing sources of greenhouse gas emissions associated with the proposed project area would be from fire (Rx Fire or managed wildfire), timber harvesting activities, transportation and mill processing activities, and distribution activities of final mill product.

Environmental Effects

Direct and Indirect Effects – Alternative 1, No Action

There would be no direct human-induced emissions of carbon into the atmosphere under the no-action alternative. The areas proposed for treatment would likely continue to function as carbon sinks until the next disturbance event (fire, wind, insect infestation, etc.) occurs. When the next stand-replacing disturbance event (high tree mortality) occurs, the affected areas would convert to a carbon source condition (such as, emitting more carbon than is being sequestered). This state would continue for up to a decade or more until the rate of regrowth meets and exceeds the rate of decomposition. As stands continue to develop, the strength of the carbon sink would increase, typically peaking at an intermediate age and then gradually declining, but remaining positive (Pregitzer and Euskirchen 2004). Carbon stocks would continue to accumulate, although at a declining rate, until again impacted by subsequent disturbance.

The risk of some high-mortality disturbance events is greater under the no action alternative. The long-term ability of these areas to persist as a net carbon sink is uncertain (Galik and Jackson 2009). Drought stress, wildfires, insect outbreaks and other disturbances may substantially reduce existing carbon stock (Galik and Jackson 2009, Hicke et al 2012). Leaving areas of forest densely stocked, as in the no-action alternative, maintains an elevated risk of carbon loss due to disturbance. Prescribed fire and other management actions are often suggested as climate change adaptation actions because they may increase forest resilience to these multiple stresses, and thus increase the likelihood of sustaining forest carbon benefits in the long-term (Millar, et al. 2007; Joyce, et al. 2008; Ryan, et al. 2008b). The no-action alternative foregoes such climate change adaptation actions.

Cumulative Effects – Alternative 1, No Action

The no action alternative has the highest potential to release carbon in a relatively large quantity over a short period due to the increased risk of a stand-replacing wildfire occurrence. Carbon would continue to be stored under the no action alternative but at a slower rate than the Proposed Action. Examples of recent large wildfires (Willis – 1987, Bridger Knoll - 1996, and the Warm Fire -2006) have resulted in type conversion from forest to brush or grass, and most of these severe burned areas will not recover or sequester carbon from the atmosphere compared to a healthy and vigorous stand of trees.

Direct and Indirect Effects – Alternative 2, Proposed Action

The Proposed Action would remove and release some carbon currently stored within treatment area biomass, through cutting vegetation and prescribed fire. Due to a timber-to-lumber component, some carbon stock locked up in products created or generated as wood products from the processing of raw timber. However, the activity of processing of that raw timber (the harvesting, transport, and milling) would also produce some carbon released into the system through greenhouse gas emissions. Long-term potential to lock up more carbon would increase because tree growth would be more robust, this is due to less competition of resources amongst the remaining trees versus the higher tree density of pre-treatment conditions. (water, sunshine, soil nutrients, etc.) (Myhre 2019).

The proposed mechanical treatments and prescribed fire treatments would reduce existing carbon stocks and temporarily reduce net carbon sequestration rates within treated stands in some areas, possibly enough that for the short term the stands would emit more carbon than they are sequestering. These stands would remain a source of carbon to the atmosphere (or weakened sink) until carbon uptake by new and remaining vegetation again exceeds the emissions from decomposing dead organic material. As stands continue to develop, the strength of the carbon sink would increase then gradually decline, but remain

positive (Pregitzer and Euskirchen 2004). Carbon stocks would continue to accumulate, although at a declining rate, until impacted by future disturbances.

The risk of some high-mortality disturbance events is greater under the no-action than under the Proposed Action. To the extent the Proposed Action reduces the risk or delay future stand-replacing disturbance events; potential emissions from those events would be reduced or forestalled.

Research has shown that the long-term gains acquired through prescribed fire and mechanical thinning outweigh short-term losses in sequestered carbon (USDA 2014) in the long-term (100 years). Thinning and burning would create more resilient forests that sequester carbon at higher rates and are less prone to stand-replacing events, and are subsequently able to store more carbon in the form of large trees. Additionally, prescribed burning and mechanical thinning would result in more open conditions conducive to understory production, particularly perennial grasses, which store subsurface carbon (Moore and Deiter 1992).

The long-term ability of forests to sequester carbon depends in part on their resilience to multiple stresses, including increasing probability of drought stress, high severity fires, and large-scale insect outbreaks associated with projected climate change. Management activities, such as those proposed that move the area toward desired conditions can maintain the capacity of the forest to sequester carbon in the long-term. Thus, even though some management activities may in the near-term reduce total carbon stored below current levels, in the long-term they maintain the overall capacity of these stands to sequester carbon, while also contributing other multiple-use goods and services (Reinhardt and Holsinger 2010).

Cumulative Effects – Alternative 2, Proposed Action

The Proposed Action would have no discernable impact on atmospheric concentrations of greenhouse gases or global warming, considering the limited changes in both rate and timing of carbon flux predicted within the affected forest acres treated over the next 20 years. Cumulatively, the Proposed Action would increase tree growth more than the no action alternative and would sequester more carbon; the Proposed Action would make the forest most resilient to climate change because it would have the lowest density of trees.

Appendices

Appendix A. Design Features

The Proposed Action would comply with forest plan standards and guidelines. Design features are incorporated into the project to protect forest resources of vegetation, soil, water, scenery values, terrestrial species habitat, and heritage resources. Mitigation measures and best management practices would be implemented during the project to limit erosion, reduce impacts to terrestrial species and habitat, to protect heritage resources, to prevent the introduction and spread of invasive plants, and to protect public health and safety.

The following design features are an integral part of this project and are part of the Proposed Action. In most cases, the environmental impacts section is based on these design features being implemented. Design features are site-specific elements developed to further define and guide the Proposed Action. They were developed for this proposal through the collaboration process with the LCI, and from the interdisciplinary team to address several issues raised during the collaborative process regarding old growth protection, large tree retention, wildlife habitat, roads, and protection of sensitive areas.

Old Growth Protection

In addition to the identified old growth patches, old growth, as defined in the forest plan vegetation management guidelines would be retained with the following exceptions:

- Where removal is required for reasons of public safety
- Specific operational considerations (such as landing areas)
- Large contiguous areas that have not been impacted by timber harvest, where fire exclusion has created forest structure conditions that are distinctly outside of the natural range of variability for the Kaibab Plateau, and where current predicted fire behavior suggests high risk of unnaturally severe wildfire and/or other degradation or desired characteristics.

In these areas, if old ("pre-European settlement") trees are cut, they would be retained on site to provide understory dead and down components consistent with old growth characteristics, except in cases where doing so would result in conditions that are clearly outside the desired range identified in the forest plan. Firewood gathering and other thinning activities would be managed and/or restricted, to retain all old growth components, including dead and downed material.

Large tree retention

Across the project area, large trees, those greater than 18-inch diameter at breast height, would be retained except where ecological restoration and biodiversity objectives cannot otherwise be met. Extensive deliberation, informed by existing data and incorporating diverse experience in managing these forests, suggests that existing conditions across the project area would make it difficult to meet objectives over extensive areas without thinning some large trees. Thus, this design criterion is not a diameter cap but rather a threshold that, when reached, requires that the removal of trees larger than 18-inch diameter at breast height be justified based on site-specific analysis of current conditions and their departure from desired conditions.

Successful implementation of the project, including monitoring the outcomes with respect to large tree retention, would provide reassurance, while pursuing an adaptive approach that would inform and improve future projects in the ponderosa pine forests of the Kaibab Plateau. Areas where desired

conditions might require removal of trees larger than 18-inch diameter at breast height include the following:

- Aspen groves or oak stands where enhancement is desired
- Areas where bark beetles are active, especially the western pine beetle and the mountain pine beetle
- Areas where within-stand openings are desirable to regain structural heterogeneity
- Areas where heavily stocked stands with high basal area are characterized by a preponderance of large, young ("post-European settlement") trees
- Encroached meadows, riparian areas, or other rare or sensitive habitats

Recognizing that desired intensity and configuration of treatments would meaningfully influence how this large tree retention policy plays out, treatments would be designed to restore, wherever possible, pre-European settlement composition, structure, and function, while considering the likelihood of continued drought and probable climate warming. Treatments would also be informed indirectly by data from reference sites across the North Rim, such as Powell Plateau and other sites that have been subject to less interrupted or altered fire regimes.

Wildlife habitat

Across the project area, maintain screening and hiding cover wherever possible during the following:

- Where mechanical thinning and wildfire result in significantly reduced tree density, maintain and stimulate well-distributed patches of cover. Proximal to roads but not continuous with old growth patches and other areas where management objectives call for the retention of denser stands with interlocking crowns, encourage regeneration stands for cover
- Use natural landforms and existing topography when thinning or revegetating to create hiding cover for wildlife
- When feasible and where beneficial, maintain strategically placed slash piles and unlopped slash for turkey cover and nesting in treated areas until post-treatment vegetation response provides natural cover and nesting sites
- Across the project area, refer to habitat parameters for Merriam's turkey (Shaw and Mollohan 1992) and mule deer guidelines (Western Association of Fish and Wildlife Agencies Mule Deer Working Group 2009)

Across the project area, retain a variety of vegetation types and structures to provide a range of habitats for wildlife species, including:

- Merriam's turkey roost sites (Ponderosa pine groups of 5-9 ponderosa pine trees 15-inch diameter at breast height)
- Gambel oak as a transition habitat for mule deer and forage for Merriam's turkey
- Interspersed trees ranging from 8-18 inches diameter at breast height, including areas of interlocking crowns, as quality pine habitat for Kaibab squirrel
- Snags around waters for bat roosts, nesting birds and other species

Across the project area, encourage a diverse understory of native grasses, forbs and shrubs to increase primary productivity and enhance the food web to benefit biodiversity:

- Consider seeding with appropriate native species using reliable seed source partnerships

Roads

- Maintain existing system of roads and prevent development of new roads. The existing system of open and administrative roads provides adequate access for project implementation. There should be no need for new permanent roads to access the treatment units or stands. However, temporary roads or permanent road improvements (such as gravel overlay) may be considered or included as part of NEPA analysis, if deemed necessary.
- Any existing closed roads reopened temporarily to access treatment units would be closed following project completion.
- Some roads may be temporarily closed during project implementation as a public safety measure.

Protection of sensitive areas

Across the project area, mitigate and avoid negative impacts to sensitive areas by using best management practices and design features such as buffers from heavy equipment around:

- Caves and karst features, including sinks
- Heritage/cultural sites
- Recreation opportunity and scenic objective areas
- Springs, seeps and draws
- Plants of cultural importance
- Sensitive soils and steep slopes; reduce active headcuts or downcuts in ephemeral drainages
- Areas of recreational interest
- Experimental or research study areas (silvicultural test plots).

Silviculture

Silvicultural prescriptions and design criteria would follow Kaibab National Forest Land Management Plan Standards and Guidelines.

- Opening size would follow forest plan guidelines for up to 4 acres with maximum width of 200 feet.
- Protection of ponderosa pine plantations established after salvage timber harvesting following the Bridger Knoll fire of 1996. These areas are designated on the map and measures would be written into the burn plans and prescribed fire prescriptions to protect and keep these plantations alive during firing operations.
- Vegetation treatments with mechanical thinning on steep slopes and sensitive soils with the option to hand pile where necessary, or masticate where appropriate, or lop and scatter where applicable.
- Within mixed conifer areas of the forest, vegetation treatments would adopt stocking guidelines for basal area and Stand Density Index from recommendations for Mexican Spotted Owl recovery plan on the Kaibab National Forest**.**

Range

Protocols from the 2005 Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds for the Coconino, Kaibab, and Prescott National Forests; appendix B-design features, best management practices, and required protection measures that are included are:

- Conducting a pre-treatment inventory inside the project area. Areas to be inventoried would be prioritized in chronological order of anticipated activity timing before the project implementation begins. Areas likely to receive higher traffic like staging areas and along roads would be monitored first and random sampling of areas planned for treatment will follow in a timely manner. Areas where high infestations of aggressive invasive species are found, planned activities in that area would be delayed until the species is controlled.
- Prioritizing treatment of invasive species found during inventory. Invasive species found during inventory would be lumped together with current known infestations and treated using the most efficient means possible and in accordance with the Coconino, Kaibab, and Prescott Record of Decision for Noxious and Invasive Weeds (2005). Once the invasive species is controlled, planned activity can begin.
- Continuation of monitoring during treatment. During project activity treatments, monitoring would be ongoing for additional species undetected during initial inventory and ensuring compliance. In the event that a new population is detected, the activity that site would be stopped until invasive species is controlled.
- Minimize soil disturbance to the extent practical, consistent with project objectives. This includes the design and need of slash piles, utilizing existing roads where applicable to decrease the need for new skid trails and fire lines.
- Washing equipment and vehicles related to activities prior to entering project area. Contracting officer would be responsible for ensuring this occurs on all equipment tied to a contract. The district would also require this policy for any vehicles and equipment used on project that came from off the district. Equipment and vehicles would also be washed before leaving the district at a pre-determined clean location.
- Ensuring weed free gravel and other materials sources. Providers of gravel and other materials used would have the source of material inspected prior to importing into the project area. If deemed necessary, material would be staged at pre-determined location for additional monitoring.
- Optimize prescribed burning for appropriate timing. Burning would be conducted during seasons of the year that promotes lower fire intensities and hinders possible weed infestation. Burning in dry years would also be avoided for improved native plant response.
- Utilizing Certified Weed Free Seed Sources. In the event that an area needs to be seeded post treatment, seed purchased would be from a reputable dealer that can provide official weed free certification for each species utilized. Seed mix would consist only of native species and/or certified sterile annuals and require approval of district range specialist or forest botanist. In the event that local seed harvesting is available and certified as “weed free”, that source would be utilized.
- Monitor after restoration treatment activity is completed. Random sampling would occur in areas that have been treated for at least two years after completion to monitor for invasive species that may have been introduced or spread.

Soil and Watershed

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

Utilize applicable guidance from the National Best Management Practices (BMPs) for Water Quality Management on National Forest System Lands, Volume 1: National Core best management practice Technical Guide (FS-990a); April 2012: The Forest Service National best management practice Program is the agency's nonpoint source pollution control program for achieving and documenting water resource protection. The National best management practice Program demonstrates the agency's commitment to land stewardship and protection of water quality consistent with the CWA, State regulations, and other requirements. The National best management practice Program is not intended in any way to circumvent or interfere with State and Tribal CWA programs, rather it is intended to support and assist the States and tribes in their efforts to ensure compliance on National Forest System lands.

The following best management practices are designed to minimize the impacts of timber harvest and fuel treatment activities to soil and water resources.

- Use of USDA-FS, Southwestern Region Terrestrial Ecosystem Survey of the Kaibab National Forest, Coconino County and Part of Yavapai County, Arizona (May 1991, as amended) Map in Timber Sale Design - Cutting units are designed in a manner that minimizes soil disturbances and facilitates best management practice implementation. Obtain a terrestrial ecosystem survey map for location of site-specific best management practices in specified terrestrial ecosystem survey map units.
- Use of Sale Area Maps for Designating Stream Courses for Water Quality Protection – Locations of designated stream courses and/or drainages, would be shown on the sale area map. Sink holes, meadows, springs seeps, and other surface waters (stock watering tanks) to be protected are also shown on sale area maps.
- Stream Course/Drainage Protection – Stream course and/or drainages to be protected are shown on the sale area map. Stream course and/or drainages are crossed perpendicularly only at designated crossings. Tractor skidding, decking of logs, fire lines, machine and hand piling of slash are not permitted within stream courses and/or drainages. Drainage features such as lead out ditches, water bars, etc., are not constructed in such a manner that surface runoff is permitted to enter a stream course and/or drainage.
- Activity generated fuels from timber harvest activities are removed from stream courses and/or drainages. Trees are to be felled outside the stream course and/or drainages. The timber sale administrator has the authority to approve skid trails and log landings outside stream courses and/or drainages.
- Log Landings – All log landing locations are approved in advance of logging activities by the Forest Service. Existing log landings would be utilized unless locations are deemed unacceptable by the Forest Service (drainage channels, steep slopes). Log landings are not located in sink holes and

meadows (terrestrial ecosystem survey map unit 9). Log landings would be located where a minimum of clearing or excavating is needed and at least 100 feet away from stream channels/drainages. Landings would be kept to the minimum size necessary to allow safe operations. Log landings are permitted within these map units if the area is less than 15percent slope and is large enough to facilitate a log landing and is accessible by an existing haul road.

- Erosion Control of Skid Trails, Landings, and Fire lines – All skid trails and fire lines would be water barred and reseeded with an erosion control native seed mix following completion of mechanized equipment operations. Lopping and scattering of slash can be substituted for water barring if the Purchaser and Forest Service agree. Skid trails and fire lines accessible from open roads would be blocked or disguised to discourage vehicle travel. Depressions such as ruts and berms are filled in or removed, restoring skid trails and fire lines to the natural grade of the slope where possible. A Forest Service approved erosion control seed mix would be applied at a minimum rate of four pounds/acre on all skid trails, landings and fire lines. In addition, skid trails and fire lines located in sensitive soils mapping unites (according to terrestrial ecosystem survey and its associated maps)may utilize water bars constructed by hand where excessive slope prevents improper water bar construction by machine. Lopping and scattering of slash can be substituted for water barring in these areas if the Purchaser and Forest Service agree.
- Limit the Operating Season – The operation of equipment would be prohibited when soil conditions are such that accelerated soil erosion, excessive soil surface displacement, or excessive compaction would occur. Ground-based mechanical falling, skidding, decking, machine piling and other off-road ground based operations would be stopped in units where soil conditions are such that soil damage is likely. The Sale Administrator would consult with soil and watershed specialist if necessary.
- Operations may occur outside the normal operating season (May 1 to November 15) when erosion control work is up to date and when the prohibitive soil conditions described above are not present. Guidelines for winter operations include reasonably dry conditions or a combination of frozen soil and snow cover conditions sufficient to minimize or eliminate soil displacement, compaction, and ground cover disturbance would be required during winter logging operations. The objective is to minimize soil compaction and displacement (rutting, etc). This applies to soils in all terrestrial ecosystem survey map units.
- Soil Loss at Tolerance – Maintain acceptable effective ground cover levels to prevent soil loss from exceeding tolerable soil loss limits. Analyze effective vegetative ground cover to determine tolerable soil loss levels. Permit light to moderate ground disturbances (vegetative ground cover is disturbed, but not displaced or removed). The Sale Administrator has the authority to require skid trail designation prior to felling to limit ground disturbance. In those areas where severe disturbance has resulted in removal of vegetative ground cover, apply harvest slash, reseed or other erosion control measures to restore the disturbed area. This applies to all terrestrial ecosystem survey map units. best management practices C, D, E, F, and G apply to designated skid trails and log landings. best management practices N, O, and P apply to roads.
- Coarse Woody Debris – To maintain or improve long-term soil productivity, manage towards a minimum of 5 to 7 tons/acre of coarse woody debris. In terrestrial ecosystem survey map unit 624, manage towards a minimum of 8 to 16 tons/acre. Coarse woody debris is defined as material greater than 3 inches in diameter. Coarse woody debris should be scattered evenly across the soil surface and represent all size classes where possible. Unmerchantable or cull trees are to remain on site and not brought into landing or decking areas. In areas (terrestrial ecosystem survey map unit 293 in the Marble Canyon Watershed, terrestrial ecosystem survey map unit 620 in the Kanab Creek Watershed and terrestrial ecosystem survey map Unit 624) where coarse woody debris is deficient, lop and

scatter slash to meet this guideline. Also, lop and scatter slash in terrestrial ecosystem survey map unit 9. This best management practice does not apply to urban interface areas or fuel breaks.

- Machine Piling of Slash – Machine pile activity generated fuels at log landings and where fuel loading exceeds target levels for Coarse Woody Debris. All machine piling would be accomplished using a Forest Service approved brush rake in order to minimize displacement of soil and rock. Machine pile when soils are frozen or dry. Machine piling of slash is not permitted in certain sensitive soils areas as determined by the terrestrial ecosystem survey. Lop and scatter activity generated fuels in terrestrial ecosystem survey map unit 9. A Forest Service approved erosion control seed mix is applied at a minimum rate of 4 pounds/acre on all landings. Reseed with native grass species.
- Hand Piling of Slash – Do not hand pile slash in designated stream courses or drainages, springs, seeps, or other designated protected areas. Within certain sensitive soils areas as determined by the terrestrial ecosystem survey vegetation would be lopped and scattered. Hand piling and burning of PCT slash can occur in Map Unit 9 only in those locations where resulting fuel loads exceed 10 tons per acre. Where appropriate, reseed with native grass species.
- Broadcast Burns – Conduct broadcast burns when moisture and temperature conditions are suitable for burning that reduces fuels without totally consuming forest duff, completely removing effective vegetative ground cover and exposing bare soil. Do not allow complete consumption of heavy concentrated fuels where the potential exist for heat to expose and damage soils. Maintain acceptable effective ground cover levels to prevent soil loss from exceeding tolerable soil loss limits. Table 3 in this report presents effective vegetative ground cover (expressed as a percent) at tolerable soil loss levels. Reseed severely burned areas with a Forest Service approved erosion control seed mix applied at a minimum rate of 4 pounds/acre. Reseed with native grass species. No broadcast burning is permitted in terrestrial ecosystem survey map unit 9 due to unsatisfactory soil conditions.
- Road Maintenance – Existing and roads to be opened for administrative use are maintained throughout the life of the timber sale. Ensure that existing drainage structures (rolling dips, culverts, rock crossings, etc.) are functioning correctly. Lead out ditches are maintained in a manner that does not allow sediment laden runoff to enter stream courses and/or drainages. Road debris and spoil material as a result of road maintenance activities is not permitted to enter any stream courses and/or drainage. Roads are to receive maintenance prior to winter shut down of logging operations. Forest Service would determine if additional or new drainage structures are needed.
- Traffic Control During Wet Periods – To prevent road damage, the use of existing and temporary roads is not permitted during wet periods. Restrictions are decided by the timber sale administrator.
- Administrative Roads to Be Closed – Roads are lightly scarified and reseeded with native grasses species effective in controlling surface erosion. Road berms are removed and ruts are filled in. Existing drainage control structures are cleaned, maintained and are working effectively. If possible, camouflage or block the road entrance to disguise the road closure.
- Servicing and Refueling Equipment – During servicing and refueling of equipment, pollutants from logging and road maintenance equipment are not permitted to enter stream courses or drainages. Select servicing areas well away from surface waters, seeps, springs, stream courses and drainages. The timber sale administrator would designate the location, size and allowable uses of service and refueling areas.
- Conduct Implementation and Effectiveness Monitoring – Refer to the soil and water monitoring plan.

Soil and Water Monitoring Plan

The intergovernmental agreement currently in effect between the Arizona Department of Environmental Quality and the USDA Forest Service, Southwestern Region requires implementation and effectiveness monitoring of best management practices. The following monitoring schedule and methodology would meet this requirement:

- Phase 1 – During Timber Sale Activities - The timber sale administrator would monitor the implementation of best management practices during timber harvesting activities. Notes taken by the timber sale administrator would be used to track any issues or problems with best management practice implementation. The Forest Soil and Watershed Specialist would provide assistance as needed by the timber sale administrator to provide clarification of best management practices specified in the Environmental Assessment.
- Phase 2 – Timber Sale Closure - The timber sale administrator would verify that the timber sale purchaser has implemented all erosion control measures prior to the closure of the timber sale. Primary responsibility would be that of the timber sale administrator with assistance from the Forest Soil and Watershed Specialist if needed.
- Phase 3 – Broadcast and Pile Burning - The District Fire Management Officer would verify that all erosion control measures associated with all burning activities has been implemented. The Forest Soil and Watershed Specialist would provide assistance, if needed.
- Phase 4 – Effectiveness Monitoring - Within the first 5 years following timber sale closure, best management practices are evaluated for effectiveness. Monitoring would concentrate on such items as erosion control measures for skid trails, log landing or decking areas, road maintenance and burned areas. Conduct a soil condition evaluation within cutting units. Focus on such items as vegetative ground cover, coarse woody debris, erosion, soil compaction and displacement. All monitoring results are documented. Primary responsibility is with the District Ranger and the Forest Soil and Watershed Specialist.
- Phase 5 – Follow Up - Documented information obtained from monitoring is used to adjust best management practices as necessary, to improve implementation and effectiveness of best management practices. Information regarding monitoring results and recommended changes to best management practices would be made available to the Arizona Department of Environmental Quality for review, as specified in the Intergovernmental Agreement. Primary responsibility is with the District Ranger and the Forest Soil and Watershed Specialist

Cultural Resources

- In order to protect cultural resource sites, all sites have been identified and documented using cultural resource survey standards as per the North Kaibab Survey Strategy (Reid and Hanson 2006). The sites would be flagged for avoidance prior to project implementation. The standard survey procedures are designed to identify and document sites visible on the surface of the ground, so in the event that an undocumented site is unearthed during ground disturbing activities, implementation activities would cease and the North Zone archaeologist would be contacted to assess the remains and complete any legal consultation required.
- Adverse effects to unevaluated cultural resource sites or sites eligible to the National Register of Historic Places would be avoided as standard practice. All design criteria would meet site protection standards in accordance with the provisions in the First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities among the Arizona State Historic Preservation Officer and the Advisory Council on Historic Preservation and United States

Department of Agriculture Forest Service Region 3 and associated appendices. Project-specific Design Criteria

- ♦ Fuels would be reduced atop fire-sensitive cultural resource sites. Fuel removal treatments would be determined based on the degree of fire sensitivity and fuel loading and may include manual thinning and low-intensity prescribed burning throughout the project area where appropriate.
- ♦ Erosion would be controlled at cultural resource sites across the project area. Treatments may include contour felling of trees, lopping and scattering of slash, hand-seeding with grasses, and application of mulch and placement of logs around sites through manual or mechanical means.

- In the event that an adverse effect cannot be avoided, mitigation measures would be designed in consultation with the Arizona State Historic Preservation Officer, the Advisory Council on Historic Preservation, and culturally affiliated tribes if applicable, following the procedures in the 36 CFR 800 regulations, in compliance with Section 106 of the National Historic Preservation Act.

Traditional and Cultural Uses

The forest would consult with tribes concerning project design and implementation. The forest would provide local tribes continued access to forest resources, and opportunities to engage in traditional practices

Fire and Fuels Activities

- A prescribed fire burn plan would be prepared for each prescribed fire treatment utilizing the interagency prescribed fire burn plan template and in accordance with silvicultural and range management prescriptions
- Broadcast burning operations would not typically occur within mechanical treatment units within the same year. The burning of slash piles would typically occur prior to broadcast burning operations. Timely and safe burning of slash piles protects people and valuable resources. However, broadcast burning within mechanical treatment units may occur within the same year, pending staff review and District Ranger approval.
- Mechanical units would be evaluated annually to ensure that follow up prescribed burning does not create more mortality then stated in silvicultural prescription
- Grazing within post-fire treated areas should not be authorized until Forest service range staff confirm range readiness.
- Develop prescribed fire treatment objectives that maintain or restore desired conditions for snags and green snags, downed logs, and per acre fuel loadings of coarse woody debris, including downed logs at the mid-scale level for each major vegetation communities found within the project area.
- All prescribed fire activity would be conducted consistent with wildlife restrictions (such as, defined nesting-breeding seasonal restrictions).
- Ignite prescribed burns when fuel moistures are high enough to prevent frequent torching of larger overstory-trees.
- Implement pre-burn preparation measures to mitigate potential negative effects to trees specifically designated for protection of both fire and field personnel and valuable resources or habitat (such as Superior trees used for cone collection, or known northern Goshawk nest trees).
- Schedule burns that avoid weather conditions, which would impact smoke sensitive areas and create excessive smoke particulate emissions at critical smoke receptor sites.

- Prescribed fire burn objectives for prescribed fire treatments within the Bridger Knoll fire history area would ensure wildlife habitat objectives are addressed when appropriate, in cooperation with Arizona Game and Fish.
- Prescribed fire treatments within the mixed conifer vegetation type would utilize treatment prescriptions that are designed to reduce potential negative effects to the key structural elements of Mexican spotted owl habitat.

Recreation and Visuals

- Mark trees on side facing away from road on trees found within 200 feet of the road edge. Do the same on trails found within 50 feet of the trail edge.
- If "leave" trees are marked within 200 feet of any Forest Service system road or within 50 feet of any system trail, use a bark-colored paint mix to cover such marks no later than the end of the season that harvest occurs, and mark on the side facing away from the road or trail.
- Sign trails/trailheads to advise the recreating public in the area of vegetative or prescribed burning treatments, schedule, and closures.
- Keep stump heights low (6 inches) within 50 ft. of trail edges.
- If sanitation cuts are used to reduce mistletoe, feather edges up to the treatment areas to avoid abrupt changes in tree densities.
- Rehabilitate skid trails, log decks, or other disturbed areas by restoring the original contours, fine grading, and seeding with native seed mix.
- Treat slash consecutively during commercial and non-commercial thinning.

Engineering and roads

- Project engineer would establish a suitable road system to implement the vegetation management project.
- Project engineer would open any closed roads for the project and re-close at project completion.
- Project would follow USDA – U.S. Forest Service, National Best Management Practices for Water Quality Management on National Forest System Lands. Volume 1: National Core BMP technical Guide (USDA FS, 2012) as applicable.

Wildlife

Condor Conservation Measures

- Prior to the start of project activities, the North Kaibab Ranger District would contact personnel monitoring condor locations and movement to determine the locations and status of condors in or near the project area.
- All workers at the project site would be advised of the possibility of the occurrence of California condors in the project area.
- All workers at the project site would be instructed to avoid interaction with condors and to immediately contact the appropriate North Kaibab Ranger District or Peregrine Fund personnel if condor(s) occur at the project area. To avoid injury to both condors and personnel, project personnel would not haze condors.

- If a condor occurs at a project site, only permitted personnel would employ appropriate techniques to cause the condor to leave the site. "Permitted" means those with the necessary federal and state permits.
- Any project activity that may cause imminent harm to condors would temporarily cease until permitted personnel can assess the situation and determine the correct course of action. It may be necessary to postpone the activity until condors leave the area or are hazed by permitted personnel.
- The project area would be kept clean (trash disposed of, tools and materials picked up) in order to minimize the possibility of condors accessing inappropriate materials.
- To prevent water contamination and potential condor poisoning, a hazardous material (including vehicle fluids) leakage and spill plan would be developed and implemented. The plan would include provisions for immediate cleanup of any hazardous substance, and would outline how each hazardous substance would be treated in case of leakage or spill.
- If condors consistently occur at the project area, then additional conservation measures may be necessary. North Kaibab Ranger District would report consistent condor occurrence at the project area to the Fish and Wildlife Service (FWS) in a timely manner, and would facilitate any necessary consideration of additional measures by North Kaibab Ranger District and the FWS.
- If condor nesting activity is known within one mile of the project area, then loud activities would be restricted to outside of the active nesting season. The active nesting season is February 1- September 30. Those dates may be modified based on the most current information regarding condor nesting and consultation with the district biologist and the Fish and Wildlife Service. North Kaibab Ranger District would report such occurrences to the FWS in a timely manner, and would facilitate any necessary consideration of additional measures by North Kaibab Ranger District and FWS.
- Smoke from project activities would be prevented from negatively affecting condor breeding. A given project fire activity would be designed and managed to prevent significant amounts of smoke, or smoke that would remain in place for an extended period of time, or chronic smoke events, from occurring in area(s) where condors are attempting to breed.

Northern goshawks

- The Kaibab National Forest Plan would be followed to protect the species, its habitat and its associated prey species.
- Limit human activities within ¼ mile of an active nest site during the breeding season so that goshawk reproductive success is not affected by human activities. The breeding season extends from March 1 through September 30.
- In northern goshawk nest areas, tree-groups may be thinned from below; Promote varied, irregular spacing between trees.

Appendix B. Relevant selections from the Kaibab National Forest Plan

The purpose of this section is to provide a ready reference to the review of the Proposed Action. Each resource area will perform in-depth analysis during NEPA and additional sections of the Forest Plan identified as relevant. The forest plan is available at:
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd517406.pdf

Fine-scale (10 acres or less) Desired Conditions for Ponderosa Pine

- Trees typically occur in irregularly shaped groups and are variably spaced with some tight clumps. Trees within groups are of similar or variable ages and may contain species other than ponderosa pine.
- Tree groups are made up of clumps of various *age classes* and size classes that typically occur in areas less than one acre, but may be larger, such as on north-facing slopes.
- Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking and consist of approximately 2 to 40 trees per group.
- The *interspaces* between groups are variably shaped, are comprised of a native grass/forb/shrub mix, and may contain individual trees or snags. Regeneration openings occur as a mosaic and are similar in size to nearby groups.
- Organic ground cover and herbaceous vegetation provide protection for soil and moisture infiltration, and contribute to plant and animal diversity and ecosystem function. Herbaceous vegetation reflects the site potential.
- Where historically occurring, Gambel oak thickets with various diameter stems and low growing, shrubby oak are present. These thickets provide forage, cover, and habitat for species that depend on them such as small mammals, foliage nesting birds, deer, and elk. Gambel oak mast (acorns) provides food for wildlife species. Large tree form oaks, snags, and partial snags with hollow boles or limbs are present.
- Where Gambel oak comprises more than 10 percent of the *basal area*, it is not uncommon for canopy cover to be greater than 40 percent.
- Isolated infestations of Southwestern dwarf mistletoe may occur, but the degree of severity and amount of mortality varies among the infected trees. *Witches' brooms* may form on infected trees, providing habitat and food for wildlife and invertebrate species.
- Fires generally burn as surface fires, but single-tree torching and isolated group torching is not uncommon.

Mid-scale (100 to 1,000 acres) Desired Conditions for Ponderosa Pine

- The ponderosa pine forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages present. Stands are dominated by ponderosa pine, but other native hardwood and conifer species occur. The more biologically productive sites contain more trees per group and more groups per area.
- Basal area within forested areas generally ranges from 20 to 80 square feet per acre, with larger trees (greater than 18 inches in diameter) contributing the greatest percent of the total basal area.

- Interspaces with native grass, forb, and shrub vegetation are variably shaped and typically range from 10 to 70 percent, with the more open conditions typically occurring on less productive sites.
- Forest conditions in some areas contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in the general forest (goshawk post-fledging family areas, Mexican spotted owl nesting/roosting habitat, drainages, and steep north-facing slopes).
- Patches of even-aged forest structure are present, but infrequent. Disturbances sustain the overall variation in age and structural distribution.
- Snags 18 inches diameter at breast height (d.b.h.) or greater average 1 to 2 snags per acre. Snags and green snags of various sizes and forms are common.
- Downed logs (greater than 12 inches diameter at mid-point and greater than 8 feet long) average 3 logs per acre. Coarse woody debris greater than 3 inches in diameter (including downed logs), ranges from 3 to 10 tons per acre.
- Fires burn primarily on the forest floor and typically do not spread between tree groups as crown fire.

Landscape-scale (over 10,000 acres) Desired Conditions for Ponderosa Pine

- The ponderosa pine forest vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. The forest is generally uneven-aged and open. Groups of old trees are mixed with groups of younger trees. Occasional areas of even-aged structure are present. Denser tree conditions exist in some locations such as north-facing slopes, canyons, and drainage bottoms.
- The ponderosa pine forest is composed predominantly of vigorous trees, but *declining* trees are present. Snags, green snags, and coarse woody debris occur across the landscape.
- Where it naturally occurs, Gambel oak is present with all structure classes represented. It is reproducing and maintaining or expanding its presence within its natural range.
- Old growth occurs throughout the landscape, generally in small areas as individual old growth components, or as clumps of old growth. Old growth components include old trees, snags, coarse woody debris, and structural diversity. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).
- The landscape is a *functioning ecosystem* that contains all components, processes, and conditions associated with endemic levels of disturbances (fire, dwarf mistletoe, insects, diseases, lightning, drought, and wind).
- Forest vegetation conditions are resilient to the frequency, extent, and severity of disturbances and climate variability. Grasses and needle cast provide the fine flashy fuels needed to maintain the natural fire regime. Fire and other disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris loads, and nutrient cycling.
- The risk of uncharacteristic high-severity fire and associated loss of key ecosystem components is low.
- Frequent, low-severity fires (Fire Regime I) occur across the entire landscape with a return interval of 0 to 35 years.

Objectives for Ponderosa Pine

- To make progress toward the desired conditions and reduce the potential for active crown fire in ponderosa pine communities at a rate that would maintain the desired conditions over time:
- Mechanically thin 11,000 to 19,000 acres annually.
- Treat an average of 13,000 to 55,000 acres annually, using a combination of *prescribed fire* and naturally ignited wildfires.

Management Approach

This plan emphasizes restoration of ponderosa pine forests because these forests are highly departed from desired conditions and were identified as a priority need for change. Projects in ponderosa pine are aimed at restoring forest structure and process (natural disturbances such as low-severity fire and dwarf mistletoe, watershed function, and nutrient cycling). Additionally, project design features may seek to increase diversity that was historically present by promoting oak, aspen, openings, and understory production. Treatments typically strive to mimic the structure and patterns of reference conditions using historical evidences and soil characteristics. However, treatments may consider other circumstances, desired conditions, and objectives, such as species specific habitat needs. As a result, reconstructed reference conditions are general guides rather than rigid restoration prescriptions.

In ponderosa pine, reintroducing fire as a disturbance agent is critical to restoration. Fire-only treatments may be appropriate for some areas with open canopies and low fuel loads, but mechanical fuel reduction is needed in many areas before fire can be safely reintroduced. Fire management needs to maintain an appropriate balance between smoke impacts and public concerns (health, visibility, etc.). Southwestern dwarf mistletoe is also a natural disturbance agent in ponderosa pine, but in some areas the degree of infection is unsustainable and exceeds desired levels. Treatments for controlling dwarf mistletoe are typically aimed at maintaining infection levels that allow for development of a diversity of age classes across the landscape, not to eliminate this naturally occurring disturbance agent. Tools for creating desired stand conditions and openings include a variety of treatments and uneven-aged cutting methods such as matrix thinning, all-size free thinning, single tree selection, group selection, sanitation and salvage, limited even-aged regeneration cutting, thinning, and managed fire.

In pine-oak forests many individual large Gambel oak trees and oak copses have become over-topped with pine trees. Treatments to promote oak regeneration and establishment are fairly effective, because oak sprouts prolifically after release treatments. Oaks may be cut or burned to stimulate new growth, maintain growth in large-diameter trees, or to stimulate mast production.

Incorporation of design features in thinning and planting prescriptions can also be used to create “living snow fences” for shade, snow accumulation, wind protection, and slow snowmelt, and protect from sublimation caused by prevailing winds. This may help offset the effects of climate change.

Pine-oak forests are managed as Mexican spotted owl (*Strix occidentalis lucida*) habitat as discussed under the approved revised Recovery Plan for the Mexican Spotted Owl (2012). The Kaibab National Forest works closely with the U.S. Fish and Wildlife Service (USFWS) to address the habitat needs of the Mexican spotted owl by minimizing disturbance and providing nest/roost habitat, which includes managing for areas of closed canopy and desired levels of key structural elements such as large old trees, snags, and downed woody debris.

Illegal woodcutting is probably the biggest threat to oak, as it reduces both the amount and quality of oak habitat. Enforcement, education, and site-specific planning will be necessary to ensure quality oak habitat

over the long term. Firewood collection opportunities are managed so site-specific planning and permits may specify the amount and size of oak that can be collected in areas where live and dead woody oak habitat components are limited.

Due to time and budget constraints in the face of increasing risk, the Kaibab National Forest intends to prioritize and design treatments so they will be most effective. One strategy includes designing treatments that make progress toward desired conditions and retain those characteristics for at least 20 years. In terms of prescriptions, this means that the post-treatment conditions may need to be on the more open end of the desired range to accommodate the growth that is anticipated in the interval between treatments. Additionally, within a given project boundary, some acres may be left untreated if they are already at low risk, or if leaving them untreated meets specific wildlife habitat needs but does not promote undesirable fire behavior at the mid-scale in surrounding treated acres.

Restoration activities would be prioritized in the areas identified by the Kaibab Forest Health Focus (Sisk et al, 2009) and then move to other areas of high risk and high value. The Kaibab Forest Health Focus was a multi-stakeholder collaborative process that prioritized areas most in need of treatment. Primary indicators were related to high risk and high value such as those with closed canopies containing large trees. These areas were identified as high priority for restoration because they already contain many components of the desired condition and a single treatment may come close to meeting the desired condition, but if lost, would take centuries to replace. The Kaibab Forest Health Focus report can be accessed at *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5120031.pdf*.

Desired Conditions for Aspen (General)

- Aspen stands are characterized by disturbances that may include fire, mechanical treatments, insects, pathogens, and abiotic factors. Collectively, these agents of change promote healthy tree regeneration, decadence, and nutrient cycling. These processes further contribute to high quality wildlife habitat and biodiversity.
- Aspen occurs in natural patterns of abundance and distribution at levels similar to or greater than those at time of plan approval.
- Aspen is successfully regenerating and recruiting into older and larger size classes. Size classes have a natural distribution, with the greatest number of stems in the smallest classes.
- Fire intervals are similar to reference conditions and maintain aspen.
- Understory vegetation consists of shrubby or herbaceous species, providing forage and cover for wildlife and habitat for invertebrates such as pollinators.
- Aspen provides opportunities for scenic enjoyment, recreation, and cultural or spiritual experiences.

Standards for Vegetation Management in All Forested Communities

- The maximum size opening that may be created in one harvest operation for the purpose of creating an *even-aged stand* shall not exceed 40 acres except when it is following a large-scale disturbance event such as a stand replacing fire, wind storm, or insect or disease outbreak.
- When openings are created with the intent of regeneration, effort shall be made to ensure that lands can be adequately restocked within 5 years of final harvest.
- Clearcutting shall only be used where it is the optimum harvesting method for making progress towards the desired conditions.

Guidelines for Vegetation Management in All Forested Communities

- Projects in forested communities that change stand structure should generally retain at least historic frequencies of trees by species across broad age and diameter classes at the mid-scale. As such, the largest and oldest trees are usually retained.
- On suitable timberlands, projects should retain somewhat higher frequencies of trees across broad diameter classes to allow for future tree harvest.
- Project design should manage for replacement structural stages to assure continuous representation of old growth over time.
- Project design and treatment prescriptions should generally not remove:
    - Large, old ponderosa pine trees with reddish-yellow, wide platy bark, flattened tops, with moderate to full crowns and large drooping or gnarled limbs (Thomson's *age class* 4, Dunning's tree class 5 and/or Keen's Tree Class 4, A and B [appendix C to Forest Plan]).
    - Mature trees with large dwarf mistletoe induced witches' brooms suitable for wildlife nesting, caching, and denning, except where retaining such trees would prevent the desired development of uneven-aged conditions over time.
    - Large snags, partial snags, and trees (greater than 18 inches diameter at breast height) with broken tops, cavities, sloughing bark, lightning scars greater than 4 inches wide, and large stick nests (greater than 18 inches in diameter).
    - Gambel oak greater than 8 inches, diameter at root collar.
    - Known bat roost trees.
- The location and layout of vegetation management activities should effectively disconnect large expanses of continuous predicted active crown fire.
- Vegetation *management prescriptions* should provide for sufficient canopy breaks to limit crown fire spread between groups, allow for the redevelopment and maintenance of a robust understory, and mimic the spatial arrangement of the reference conditions.
- Vegetation management activities in mixed conifer forests should incorporate experimental design features and monitoring to accelerate learning and adaptive management.
- Trees established after 1890 should generally not be retained in areas where biophysical conditions would have supported stable openings over time.
- Vegetation management activities should meet or exceed goals for scenic beauty (*scenic integrity objectives*) by creating natural patterns, structure and composition of trees, shrubs, grasses, and other plants.
- Vegetation management should favor the development of native understory species in areas where they have the potential to establish and grow.
- *Even aged silvicultural practices* may be used as a strategy for achieving the desired conditions over the long term, such as bringing dwarf mistletoe infection levels to within a sustainable range, or old tree retention.
- Seed and plants used for revegetation should originate from the appropriate PNVT and general ecoregion (i.e. southern Colorado Plateau) as the project area.
- Heavy equipment and log decks should not be staged in montane meadows.

See also "Recreation and Scenery," "Nonnative Invasive Species," "Wildlife", "Threatened, Endangered, and Sensitive Species", and relevant major vegetation communities.

Management Approach

The above Standards for Vegetation Management are required for meeting the intent of the National Forest Management Act. On the Kaibab National Forest, the predominant vegetation management strategies are *uneven-aged* management systems. This is because vegetation management objectives were only developed for the ponderosa pine and frequent fire vegetation types, both of which have uneven aged desired conditions. Even aged management prescriptions are, however, used as a strategy for achieving the desired uneven-aged conditions over the long term. Even-aged prescriptions are appropriate when they would increase or maintain a trajectory toward desired conditions such as to regenerate aspen or when mistletoe infections are moderate to severe and the ability of the area to achieve the desired conditions would be significantly impaired.

Guidelines for Soils and Watershed Management

- Projects should incorporate the national best management practices for water quality management and include design features to protect and improve watershed condition.
- In disturbed areas, erosion control measures should be implemented to improve soil conditions.
- Seeds and plants used for revegetation should originate from the same PNVT and general ecoregion (i.e. southern Colorado Plateau) as the project area.

Desired Conditions for Wildlife

- Native wildlife species are distributed throughout their potential natural range. Desirable nonnative wildlife species are present and in balance with healthy, functioning ecosystems.
- Habitat is available at the appropriate spatial, temporal, compositional, and structural levels such that it provides adequate opportunity for breeding, feeding, nesting, and carrying out other critical life cycle needs for a variety of vertebrate and invertebrate species.
- Species with specific habitat needs (snags, logs, large trees, interlocking canopy, and cavities) are provided for.
- Grasses, forbs, and shrubs provide forage, cover, fawning, and nesting sites.
- Interconnected forest and grassland habitats allow for movement of *wide ranging species* and promote natural predator-prey relationships, particularly for strongly interactive species (mountain lions).
- Habitat configuration and availability allow wildlife populations to adjust their movements (seasonal migration, foraging, etc.) in response to climate change and promote genetic flow between wildlife populations.
- Human-wildlife conflicts are minimal. Hunting, fishing and other wildlife based recreation opportunities exist, but do not compromise species populations or habitat.

Guidelines for Wildlife Management

- Project activities and special uses should be designed and implemented to maintain refugia and critical life cycle needs of wildlife, particularly for raptors.

- Project activities and special uses should incorporate recommended measures for golden eagle management such as temporary closures to limit human disturbance in the vicinity of golden eagle nests.
- Potentially disturbing project-related activities should be restricted within 300 yards of active raptor nest sites between April 1 and August 15.

Management Approach

The Kaibab National Forest strives to create and maintain natural communities and habitats in the amounts, arrangements, and conditions capable of supporting *viable populations* of existing native and desired nonnative plant, aquatic, and wildlife species within the planning area while contributing to broader landscape-scale initiatives where appropriate. This is accomplished in an integrative fashion by working closely with range, fire, timber, and other resource areas to coordinate and maximize activities for wildlife benefit. Cooperation with State and federal wildlife management agencies also helps to minimize conflicting wildlife resource issues related to hunted, fished, and trapped species. The Kaibab National Forest coordinates with Rocky Mountain Research Station and other entities to identify future areas of research that would support management decisions and enable the adaptive management process.

The Kaibab National Forest continues to support the AGFD in various capacities directed toward managing wildlife, fish, and habitat. Areas for potential collaboration include (but are not limited to) achieving management goals and objectives specified in Arizona's State Wildlife Action Plan (SWAP), carrying out memoranda of understanding (MOUs) and the cooperative agreement for management of the Grand Canyon National Game Preserve, and management of recreation fisheries.

The Kaibab National Forest works closely with the BLM, Grand Canyon National Park, and AGFD in managing desert bighorn sheep, and California condor (*Gymnogyps californianus*). Kaibab National Forest has been working and will continue to collaborative with the Arizona Wildlife Linkages Workgroup to implement strategies identified in the "Arizona Wildlife Linkages Assessment" as well as the "Coconino County Wildlife Corridor Assessment."

The Kaibab National Forest cooperates with State, Federal, and nongovernmental organizations to reestablish naturally occurring species that have been affected by anthropogenic activities. These include species such as the California condor and northern leopard frog (*Lithobates pipiens*), and where feasible and appropriate, the recovery and/or restoration of strongly interactive species within their historical range.

Potential climate change, drought, El Niño Southern Oscillation (ENSO), and the resulting potential effects of management activities are considered during project planning. Particular species that are sensitive to changes in weather may need special consideration. Changes in typical weather patterns can affect migration habitat use, breeding seasons, and fecundity (i.e., in hotter, drier years, mitigations may be needed to reduce physiological stress on breeding wildlife). Climate change is an important consideration when managing habitat for wildlife species.

The Kaibab National Forest references current literature and the best available science when making site specific decisions relevant to project planning. This is done in an interdisciplinary context with input from other resource specialists. For example; the wildlife guideline specifying disturbance buffers around raptor nests is intended as a minimum buffer. Some raptor species (osprey) are more adapted to disturbance and are likely to tolerate a buffer of just 300 yards during the breeding season while other, less tolerant species (peregrine falcons (*Falco peregrinus*)) may require buffers of up to a ½ mile. Wildlife biologists work with other interdisciplinary team resource specialists to identify and define the

appropriate site-specific buffers (within the context of plan guidance) for other raptors on a case-by-case basis.

Threatened, Endangered, and Sensitive Species

Threatened and endangered species are those listed under the Endangered Species Act of 1973. On the Kaibab National Forest, these species currently include the California condor, Mexican spotted owl, Apache trout (*Oncorhynchus apache*), and Fickeisen Plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) (proposed). Region 3 Sensitive Species[12] are those plants and animals identified by the Regional Forester for which population viability is a concern. The primary needs for threatened, endangered, and sensitive species are addressed through law, regulation, and policy (recovery plans and conservation agreements). As a result, this plan provides the framework for implementing the recommendations from these higher-level laws, regulations, policies, plans, and agreements for threatened, endangered, and sensitive species, with limited needed additional (below) direction.

Desired Conditions for Threatened, Endangered, and Sensitive Species

- Threatened, endangered, and sensitive species have quality habitat, stable or increasing populations, and are at low risk for extirpation.
- Goshawk *nest areas* are multi-aged forests dominated by large trees with interlocking crowns and are generally denser than the surrounding forest.

Guidelines for Threatened, Endangered, and Sensitive Species

- Project activities and special uses occurring within federally listed species habitat should integrate habitat management objectives and species protection measures from approved recovery plans.
- Project activities and special uses should be designed and implemented to maintain refugia and critical life cycle needs of Forest Service Sensitive Species.
- Activities occurring near areas used by bald eagles should follow recommendations identified in the National Bald Eagle Management Guidelines and Arizona Conservation Assessment and Strategy for the Bald Eagle.
- A minimum of six goshawk nest areas (known and replacement) should be located per territory. Nest and replacement nest areas should generally be located in drainages, at the base of slopes, and on northerly (NW to NE) aspects. Nest areas should generally be 25 to 30 acres in size.
- Goshawk post-fledging family areas of approximately 420 acres in size should be designated surrounding the nest sites.
- Potentially disturbing project-related activities should be minimized in occupied goshawk nest areas during nesting season of March 1 through September 30.

Management Approach

The Kaibab National Forest maintains strong partnerships between the State, other federal agencies, academia, and nongovernment organizations to provide for threatened, endangered, and sensitive species. Emphasis is placed on the protection and replacement of key habitats that contain threatened, endangered, and/or sensitive species of plants and animals. The Kaibab National Forest works with the USFWS and other partners to develop conservation measures (public education to reduce human impacts) to prevent

[12] The Regional Forester's Sensitive Species List for the Southwestern Region can be found at http://www.fs.usda.gov/detail/r3/plants-animals/?cid=FSBDEV3_022105

listing and to aid to in the recovery and delisting of federally listed species. For 10(j) species, such as the California condor, this applies inside and outside the designated experimental range.

See also "Wildlife", "Natural Waters," "Caves, Karsts, and Mines," "Cliffs and Rocky Features," "Pediocactus Conservation Area," and "Arizona Bugbane Botanical Area."

Rare and Narrow Endemic Species

Some species face threats simply by virtue of their relatively limited distribution. Species (or subspecies) are considered to have a restricted distribution if they are limited in extent in the Southwest. A species is considered a narrow endemic if it has extremely limited distribution and/or habitat in northern Arizona. Due to limited distributions and potential susceptibility to perturbations, some species may require specific management considerations. On the Kaibab National Forest there are currently 74 known species for which restricted distribution is considered a threat; of these, 48 are narrow endemics, some of which are one the Regional Forester's sensitive species list (see above).

Desired Conditions for Rare and Narrow Endemic Species

- Habitat and refugia are present for narrow endemics or species with restricted distributions and/or declining populations.
- Location and conditions of rare and narrow endemic species are known.

Guidelines for Rare and Narrow Endemic Species

- Project design should incorporate measures to protect and provide for rare and narrow endemic species where they are likely to occur.

Management Approach

Species-specific information and management recommendations can be found in the Kaibab National Forest endemic species guidebook, which is to be maintained as a living document and updated with new species, information, and locations as they become available.

Desired Conditions for Nonnative Invasive Species

- Invasive species are contained and/or controlled so that they do not disrupt the structure or function of ecosystems or impact native wildlife.
- Visitor experiences are not adversely impacted by the presence of invasive species.

Guidelines for Nonnative Invasive Species

- All ground-disturbing projects should assess the risk of *noxious weed* invasion and incorporate measures to minimize the potential for the spread of noxious and invasive species. New populations should be detected early, monitored, and treated as soon as possible.
- Treatment approaches should use integrated pest management (IPM) practices to treat noxious and nonnative invasive species. IPM includes manual, biological, mechanical, and herbicide/pesticide treatments.
- Use of pesticides, herbicides, and biocontrol agents should minimize impacts on non-target flora and fauna.

Management Approach for Nonnative Invasive Species

Strategies to prevent the spread of nonnative invasive species include education, inventory, and control guidelines. Educational programs that increase awareness are critical to effectively manage nonnative invasives. Treatments focus on those species that have the potential to permanently alter historical fire regimes or pose the greatest threat to biological diversity and watershed condition. To effectively manage invasive species populations, it is important to coordinate with other agencies, grazing permittees, and adjacent landowners in efforts for prevention and control.

- While management that provides for interconnected habitats is desirable for many native wildlife species. In some circumstances such as springs, connectivity can also provide vectors for nonnative species to spread (water and vehicles used in fire suppression). The use of best management practices can minimize and prevent the spread of non-native invasive species.

Desired Conditions for the Grand Canyon Game Preserve

- The Grand Canyon Game Preserve provides quality habitat for game animals.
- There are a variety of vegetation types, in all stages of development, which provide a range of habitats for native and desired nonnative wildlife species, including natural predators.

Management Approach for the Grand Canyon Game Preserve

The Kaibab National Forest cooperates with the AGFD in carrying out the cooperative agreement for managing the Grand Canyon Game Preserve. The game preserve is managed in the spirit of the original proclamation, informed by advances in scientific information and societal values, with an emphasis on the wise use of natural resources.

Desired Conditions for the Kaibab Squirrel National Natural Landmark

- The Kaibab Squirrel National Natural Landmark provides quality ponderosa pine habitat for the Kaibab squirrel.

Management Approach for the Kaibab Squirrel National Natural Landmark

The needs for the Kaibab Squirrel National Natural Landmark (NNL) are addressed in the forest plan direction for the ponderosa pine vegetation type. The Kaibab National Forest continues to work collaboratively with the National Park Service (NPS) NNL Program Intermountain Regional Coordinator, as well as other interested parties, in developing a better understanding of the habitat use, distribution, and conservation needs of this unique species. Direction for areas with NNL designations requires Federal agencies to consider the unique properties of the NNL in their planning and impact analysis (Fed. Reg. 64: 25718) and provides opportunities to secure funding and develop partnerships to achieve management and conservation goals.

Desired Conditions for Cultural Resources

- Cultural resources, including known traditional cultural properties, are preserved, protected, or restored.
- Historic artifacts are preserved in situ or, when necessary, curated following current standards.
- All historic properties are evaluated for their eligibility to the National Register and properties that are appropriate are listed to the National Register of Historic Places.

- Cultural resource findings will be synthesized and shared with the scientific community and public through formal presentations, publications, and educational venues.
- Public understanding about the cultural resources and historic preservation issues contribute to their protection.
- The Kaibab National Forest historic documents, including photographs, maps, journals, and Forest Service program management records, are available to the public for research and interpretation.

Management Approach for Cultural Resources Protection

The Kaibab National Forest has been working and will continue to work to identify, evaluate, and protect cultural resources. Collaborative partnerships and volunteer efforts that will assist the Kaibab National Forest in historic preservation will be developed and maintained. The Kaibab National Forest uses a proactive approach in protecting cultural resources from adverse impacts and conducts outreach to educate the public on the history of the area and historic preservation issues. Additionally, the Kaibab National Forest seeks opportunities to do additional survey beyond the stated objective of 200 acres per year when funding and other resources are available. Partnerships with federally recognized tribes help to protect ancestral sites and manage cultural resources through meaningful collaboration. The Kaibab National Forest recognizes that there are important Tribal sacred sites, ethnographic resources and traditional use areas that may not meet the definition of a historic property. The Kaibab National Forest works to protect these resources using existing authorities in collaboration with federally recognized tribes. Memoranda of understanding with federally recognized tribes promote strong working relationships by addressing issues of mutual concern.

Desired Conditions for Recreation and Scenery

- A wide spectrum of high-quality recreation settings exists. Users have access to a variety of developed and dispersed opportunities.
- The Kaibab National Forest provides sustainable recreation consistent with public demand. Use levels are compatible with other resource values.
- Conservation education actively engages children and adults resulting in increased forest stewardship, ecological awareness, partnerships, and volunteerism. Information and educational programs provide opportunities to connect youth, low-income, and minority populations with nature.
- Visitors have access to information that enriches their recreation experiences and contributes to an understanding of their role in public land stewardship. “Leave No Trace,” “Tread Lightly,” fire prevention, wildlife awareness (lead reduction, Be Bear Aware, Animal Inn, etc.), and archaeological resource protection principles are promoted and practiced by the visiting public.
- Opportunities for off-highway vehicle (OHV) riding and driving for pleasure are available on the designated system of National Forest System roads and motorized trails.
- Recreation management activities complement and support local economies and tourism.
- User conflicts are infrequent.
- The Great Western Trail[16] route can be driven boundary to boundary through each of the districts where it occurs. Signage helps to identify and highlight the route.
- The historic character of the Beale Wagon Road and Overland Road trails is preserved.

Management Approach for Recreation and Scenery

Recreation management decisions on the Kaibab National Forest are guided by three primary approaches. These approaches are aimed at providing managers a more complete framework for considering management actions. Their purpose is to minimize new development in remote settings and to protect and manage both low and high use areas and facilities. These approaches guide actions in response to changing or increasing use.

- **Provide a range of recreation opportunities**. Manage in a way that maximizes the opportunities available to all types of recreationists to the degree allowed by this plan and other agency regulations.
- **Concentrate use at specific sites or locations rather than dispersing use within the area or to other areas**. In keeping with the principles of recreation ecology, this approach would assure that impacts associated with recreational use are constrained to particular areas.
- **Minimize the extent to which forest management actions disperse use from high to low use areas**. This would help accomplish the goal of constraining the number and size of areas impacted by recreational use where possible.

The ultimate goal of these approaches is to maintain the visitors' perceived freedom to recreate how and where they choose, while retaining healthy, sustainable public lands. When impact and user capacity questions arise, indicators and standards to determine how and where to allocate visitor use should be employed. These approaches would not preclude the Kaibab National Forest from developing new sites or adapting old sites to accommodate new uses, provided appropriate analyses are conducted to make those decisions.

As the population in northern Arizona and the popularity of mountain biking and OHV use continues to grow, the pressure for more trails will likely increase. Any new trail development needs to strike a balance between opportunities for different types of recreation and other resource concerns. Due to the nature of motorized, equestrian, and bicycle trail use, regular maintenance is needed. Partners, volunteers, and potentially a fee system could help to provide increased capacity and revenue for maintenance materials, operation, education, and enforcement of regulations.

Many forest users have expressed concerns about recreation use impacts and a desire for opportunities to engage in shared stewardship of the Kaibab National Forest. With limited Forest Service budgets and increased recreation pressure, volunteers and partners will likely play an increasingly important role in helping to construct and maintain trails and manage dispersed camping, especially at popular areas such as viewpoints.

The Kaibab National Forest places emphasis in its specific niches. As such, recreation opportunities on the North Kaibab Ranger District emphasize dispersed recreation, non-motorized trail and wilderness opportunities, while on the Williams and Tusayan districts, the recreation emphasis is on day-use areas, developed recreation opportunities, and facilities such as campgrounds.

Desired Conditions for Air Quality

- Air quality meets or surpasses State and Federal ambient air quality standards.
- Management activities on the Kaibab National Forest do not adversely impact Class I Airshed visibility as established in the Clean Air Act.

Management Approach for Air Quality

Public tolerance for nuisance smoke, rather than law, regulation, or policy, effectively sets the social limit to the number of acres that can be treated with wildland fire. Community public relations and education, coupled with pre-burn notification, greatly improve public acceptance of fire management activities. In order to maintain public support for prescribed burns and the use of wildfires to accomplish resource benefits, it is important that land managers be responsive to the public's tolerance thresholds to balance ecological benefits with social and economic values. The public will tolerate several days of nuisance smoke in a row, and up to several weeks total a year, but even the most supportive have tolerance limits. Public acceptance of smoke varies greatly from year-to-year. Acceptance of smoke from prescribed fires and wildfires is high following seasons with high profile, high-severity events, and during extremely dry years when the threat of large, high-severity incidents is elevated. Conversely, acceptance wanes during wetter years when the threat of uncharacteristic fires is low.

Control measures developed for site specific projects can reduce these localized particulate matter emissions. Examples include reducing travel speeds on unpaved surfaces, ceasing work activities during periods of high winds, applying gravel or soil stabilizers on dust problem areas, covering loads, and covering ground surfaces with water during earth moving activities.

Desired Conditions for Natural Waters

- Stream channel stability and aquatic habitats retain their inherent resilience to disturbances and climate fluctuations. Stream channel morphology reflects changes in the hydrological balance, runoff, and sediment supply appropriate to the landscape setting.
- Springs and ponds have the necessary soil, water, and vegetation attributes to be healthy and functioning. Water levels, flow patterns, groundwater recharge rates, and geochemistry are similar to reference conditions. Springs, streams, and ponds have appropriate plant cover to protect banks and shorelines from excessive erosion.
- Hydrophytes and emergent vegetation exist in patterns of natural abundance in wetlands and springs in levels that reflect climatic conditions. Overhanging vegetation and floating plants such as water lilies exist where they naturally occur.
- The necessary physical and biological components, including cover, forage, water, microclimate, and nesting/breeding habitat, provide habitat for a diverse community of plant and wildlife species.
- Riparian dependent plant and animal species are self-sustaining and occur in natural patterns of abundance and distribution. Within its capability, stream flow and water quality are adequate to maintain aquatic habitat and water sources for native and desired nonnative species.[7] Native macroinvertebrates are appropriately abundant and diverse.
- Native amphibians are free from or minimally impacted by nonnative predation and diseases. Unwanted nonnative species do not exert a detectable impact on aquatic and wetland ecosystems
- Where springs or other natural waters have been modified for livestock and/or human consumption, developments are operational.
- The location and status of springs and water resources are known, organized, and available.

Management Approach for Natural Waters

Due to the limited information available, Kaibab National Forest efforts and emphasis are placed on improving knowledge on the distribution of water resources and aquatic or wetland biota, resource protection, and rehabilitation of springs, including groundwater flow and geochemical analyses. Potential

management activities include fencing or other physical protections, restoration of diversions, and revegetation with native species.

Develop collaborative strategies and partnerships for spring inventory, assessment, restoration, monitoring, and research when appropriate. Use volunteers to maintain and improve fence exclosures and decrease agency maintenance costs.

The Forest Service and Arizona Department of Environmental Quality (ADEQ) share the common objective of improving and protecting the nation's waters. ADEQ serves as the designated management agency within the context of the Arizona Water Quality Management Program for all National Forest System lands within Arizona. The Kaibab National Forest coordinates with ADEQ to ensure Forest Service projects meet the requirements of State Water Quality Management Plans and the Nonpoint Source Management Program developed pursuant to Federal regulations and the Clean Water Act.

To meet common objectives, the Kaibab National Forest works with partners and stakeholders (i.e., Museum of Northern Arizona, Grand Canyon Wildlands Council, The Nature Conservancy, Grand Canyon Trust , National Park Service (NPS), AGFD, and USFWS) to develop a Geographic Information System (GIS) layer of northern Arizona springs and seeps. The Kaibab National Forest also collaborates with stakeholders and uses public education and outreach to garner support for spring restoration.

Large Tree Retention Classes for Ponderosa Pine (from appendix C to the forest plan)

Age Class Descriptions

Dunning (1928) Age Class 5: Overmature; usually largest trees in stand; bark light yellow with wide, long and smooth plates; tops flat with terminals rarely discernible; nearly all branches are drooping, gnarled, and crooked.

Keen (1943) Age Class 4: Overmature; making no further height growth; diameter growth very slow; bark light yellow, uniform for entire bole (except in extreme top), with wide, long and smooth plates and often shallow fissures; tops usually flat or occasionally rounded or irregular; branches large, heavy, and often gnarled or crooked and mostly drooping except in extreme top.

Thomson (1940) Age Class 4: Mature to overmature; trees usually large; bark reddish-brown to yellow with wide, long and smooth plates; tops usually flat and making no further height growth; branches mostly large and drooping, gnarled or crooked.

Kaibab National Forest's Climate Change Approach for Plan Revision

(from appendix D to the forest plan)

Wildfire

Historically, wildfires have played an important role in the vitality of fire-adapted ecosystems. Past forest management and fire suppression practices have changed the dynamics of fire on the landscape within the Southwestern Region's national forests and grasslands, resulting in greater fuel loads and risk of wildfire. Federal land management agencies in the West routinely exceed expenditures of over $1 billion per year for wildfire suppression. Since about the mid-1970s, the total acreage of area burned and the severity of wildfires in ponderosa pine and mixed conifer forest have increased.

Fire frequency and severity are likely to increase as temperatures rise and precipitation decreases. Severe wildfires reduce the land's ability to sequester and store carbon. Population growth in the Southwest may also lead to greater numbers of human-caused wildfires. The 2002 Rodeo-Chediski Fires and the 2011 Wallow Fire in Arizona were started by humans. Combined, these fires burned over a million acres.

Outbreaks of Insects, Diseases, and Nonnative Invasive Species

Disturbances associated with climate change can have secondary impacts indirectly caused by wildfire and climate related extremes. Increased variation in temperature and moisture can cause stress and increase the susceptibility of forest ecosystems to invasions by insects, diseases, and nonnative species. New environmental conditions can lead to a different mix of species that tend to favor plants and animals that can adapt their biological functions or are aggressive in colonizing new territories (Whitlock 2008). However, changes in adaptability may be too slow given the predicted rate of change. Species that are already broadly adapted may become more prevalent and species with narrow adaptability may become less prevalent. Disturbance factors that create more vulnerability in native ecosystems or require extensive controls to maintain the status quo are likely to adversely affect the health and diversity of forests.

Desired conditions for healthy forests include resilience to dramatic changes caused by abiotic and biotic stressors and mortality agents (pine beetle) and a balanced supply of essential resources (light, moisture, nutrients, growing space). Insects and diseases typically invade in cycles followed by periods of relative inactivity. Nonnative invasive species, such as cheat grass and salt cedar, are expected to continue to

increase in numbers and extent. Vulnerabilities to forest threats from an environment that may be much different from the historic range of natural variability is an active area of research, and includes developing new management approaches for changing conditions.

Diminishing Water Resources

Locations of most snowpack and upland reservoirs are on national forests in the Southwest. In much of the Southwest, less precipitation is falling as snow and spring melting is occurring earlier in the year. The Colorado River, Rio Grande, and several other southwestern rivers have stream flows that appear to be peaking earlier in the year, suggesting that the spring temperatures in these regions are warmer than in the past, causing snow to melt earlier. Water supplies are projected to become increasingly scarce, calling for tradeoffs among competing uses, potentially leading to conflict. In the Southwest, intense debate is likely to occur over resource allocation and conservation of available supplies.

Climate Related Socioeconomic Demand

Populations in Arizona and New Mexico are growing at an unprecedented rate. As of the American Communities Survey in 2006, Arizona's population was over 6 million. The total increase for Arizona between 1980 and 2006 was 123 percent. The combination of population growth and climate change would likely exacerbate climatic effects, putting even greater pressure on water, forests, and other resources. Climate change could have long-term impacts on many of the amenities, goods, and services from forests, including productivity of locally harvested plants; local economics through land use shifts from forest to other uses; forest real estate values; and tree cover and composition in urban areas and associated benefits and costs.

Climate Change and Wildlife Habitat

While climate change has the potential to affect all wildlife species, some are inherently more vulnerable than others, particularly species with specialized niches, limited mobility, and limited physiological adaptability. Certain habitats are more vulnerable to a changing climate. For example, springs and seeps are a valuable natural water source for a variety of birds and mammals, particularly in arid environments. These areas may offer critical refugia for rare and narrow endemic species. However, springs are especially sensitive to variable precipitation and likely to dry up during prolonged drought. As such, the unreliability of natural water resources would make it harder for wildlife species to persist, pushing the limits of their natural range.

Managing for landscape connectivity will be important, as connectivity facilitates movement of species among habitats (Taylor et al. 1993, Millar et al. 2007). Connectivity has two components, structural and biological connectivity and biological components. Structural connectivity, the spatial structure of a landscape, can be described from map elements. Biological connectivity is the response of individuals to the scale of landscape features (Brooks 2003). Promoting connectivity in landscapes with flexible management goals that can be modified as conditions change may assist species to respond naturally to changing climates. Reducing fragmentation and planning at landscape scales to maximize habitat connectivity will become increasingly important (Millar et al. 2007).

Management Strategies to Address Key Climate Change Concerns

Actions to address climate change factors of most concern are those that:

1. Reduce vulnerability by restoring and maintaining resilient native ecosystems;
2. Anticipate increases in forest recreation;

3. Use markets and demand for wood and biomass for restoration, renewable energy, and carbon sequestration;
4. Enhance adaptation by anticipating and planning for intense disturbances;
5. Conserve water; and
6. Monitor climate change influences.

Managing ecosystems under uncertainty necessitates flexible and adaptive approaches that are reversible, are implemented in incremental steps, allow for new information and learning, and can be modified with changing circumstances (Millar et al. 2007). Southwestern ecosystems have evolved under a long and complex history of climate variability and change. Taking into consideration the number of mega-droughts and other climate related variation, through time, southwestern systems have some built-in resilience. The revised plan focuses on restoring and maintaining resilience in forest and grassland ecosystems. Risks of increased wildfire, insects and disease outbreaks, and invasive species represent ongoing, broad-scale management challenges. These issues are not new. However, climate change has the potential to increase and exacerbate the impacts of these ecosystem risks.

Because our understanding of climate change is rapidly evolving, management decisions that are robust to uncertainty, while being both strategic and tactical in nature, would likely be most effective at managing for climate change. Peterson et al. (2011) have developed a guidebook for climate change response on national forests. It recommends the following strategies that incorporate both science and management: (1) become aware of basic climate change science and integrate that understanding with knowledge of the local resource conditions and issues (review); (2) evaluate sensitivity of natural resources to climate change (rank); (3) develop and implement options for adapting resources to climate change (resolve); and (4) monitor the effectiveness of on-the-ground management (observe) and adjust as needed.

Restoring and maintaining resilience would likely improve the potential for ecosystems to retain or return to desired conditions after being influenced by climate change related impacts and variability. Managing for resistance (maintenance thinning to prevent catastrophic fire, forest insect or disease pandemics) and resilience (noxious weed control) offer meaningful responses to climate change.

Prescribed fires are a management tool that can serve multiple purposes, from sustaining desired conditions for fire-adapted ecosystems and sustaining habitat for threatened and endangered species to reducing fuel loads. Prescribed burning is also a management strategy that will be important for maintaining desired habitats in a changing climate with more natural disturbances. With projections of more frequent storms and other more extreme weather events and increased stress from forest pests in a warmer, drier climate, prescribed burning will continue to be an important management strategy for the future.

Forests serve as significant carbon reservoirs; however, large-scale fire events can counter this benefit by releasing significant amounts of carbon into the atmosphere. Fuel treatments (thinning, prescribed fire), as identified in the Proposed Action, promote low-density stand structures characterized by larger, fire resistant trees. This strategy should afford greater carbon storage in southwestern fire-adapted ecosystems over time (North et al. 2009, Hurteau and North 2009). Although fire-excluded forests contain higher carbon stocks, this benefit is outweighed in the long term by the loss that would be likely from uncharacteristic stand-replacing fires (Hurteau et al. 2011) if left untreated.

Prescribed burning helps to mitigate the negative impacts of stand-replacing fire in dry, dense forests by consuming less biomass and releasing less carbon into the atmosphere (Wiedinmyer and Hurteau 2010). Further, research has shown that the long-term gains acquired through prescribed fire and mechanical

thinning outweigh short-term losses in sequestered carbon. In the long term (100 years), thinning and burning would create more resilient forests that are less prone to stand-replacing events, and subsequently able to store more carbon in the form of large trees.

Slash resulting from mechanical thinning can be used in place of fuels (North and Hurteau 2011, Sorenson et al. 2011). Not all forest products sequester carbon equally. For example, products with longer on average lifespans (houses), have a greater potential to store carbon than short-lived products such as fence posts. In addition, biomass products created from slash can be used in place of fossil fuels, greatly reducing carbon emission into the atmosphere (Ryan et al. 2010). These types of discussions of tradeoffs in emission and carbon storage rates are likely to be increasingly relevant in decision making. Wood products that can substitute for building materials such as steel and concrete produce far less greenhouse gas emissions during their production while simultaneously sequestering carbon (Ryan et al. 2010).

Although current programs and guidance are already in place to limit introduction of nonnative species, treat invasive species, and control insects and diseases, these efforts are likely to become more critical to maintaining desired conditions for healthy forests under a changing climate. Due to the fragmented land ownership patterns, success in reducing forest pests requires going beyond national forest boundaries, and continued collaboration with partners will be needed. In addition, management practices (such as prescribed selection cutting for age class diversity) that sustain healthy forests and provide adequate nutrients, soil productivity, and hydrologic function promote resilience and reduce the potential for disturbance and damage.

The Wildlife Society with the Inkley et al. (2004) recommended several actions to help wildlife adapt to climate change and its potential effects on wildlife. These include: (1) managing for diverse conditions; (2) reducing nonclimate stressors on ecosystems; (3) reducing the risk of uncharacteristic high-intensity fires; (4) conducting medium and long-range planning; (5) ensuring ecosystem processes; and (6) employing monitoring and adaptive management, as well as controlling for invasive plant species. Finally, it will be important to set priorities by appropriately balancing sensitive and vulnerable species and systems with those that are resistant and resilient (Glick and Edelson 2011).

On the Kaibab National Forest, existing collaborations between the AGFD and Coconino County generally encourage the protection of open lands and the preservation of the land's natural character within local and regional contexts. These collaborative strategies should decrease the potential for future land fragmentation while improving the overall integrity of the landscape. This should also provide for more resilience with regard to climate change for those wildlife species that may need to adjust migration routes, foraging corridors, or breeding grounds.

References

(Note: Based on additional reviews of this Preliminary Environmental Assessment and comments received from stakeholders and the public, this reference section may change and/or be updated between the preliminary and final versions of the EA. The Council on Environmental Quality encourages the use of appendices and incorporation by reference in the body of an environmental analysis, when appropriate).

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