Chapter 3. Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It presents the assumptions and methodologies used to analyze the effects of the alternatives, which is the scientific and analytical basis for comparing the alternatives. Only summaries are provided here for each resource area. All specialist reports in their entirety are incorporated by reference and are available on the 4FRI Rim Country webpage at: www.fs.usda.gov/goto/4FRIRimCountry.

Law, Regulation, and Policy

Applicable laws, regulations, policies, and executive orders, as well as Forest Service manual and handbook guidance, memoranda of understanding, conservation strategies, and programmatic agreements, are listed here by resource area. For more information on these, forest plan direction, and other guidance, see the individual resource specialist reports. The relevant documents are available on the Forest Service website (http://www.fs.fed.us/publications/) and from Forest Service offices.

All

- Organic Administration Act of 1897 (at 16 U.S.C. 475, 551)
- Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. 528-531)
- National Environmental Policy Act of 1969 (16 U.S.C. 4321 et seq.)
- Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974, as amended by the National Forest Management Act (NFMA) of 1976 (16 U.S.C. 1600-1614, 472a)
- 40 CFR 1500 Council on Environmental Quality

Watershed and Soils

- Organic Administration Act of 1897
- Weeks Law of 1911
- Knutson-Vandenberg Act of 1930
- Bankhead-Jones Farm Tenant Act of July 22, 1937
- Federal-State Cooperation for Soil Conservation Act of December 22, 1944
- Anderson-Mansfield Reforestation and Revegetation Joint Resolution Act of 1949
- Granger-Thye Act of 1950
- Watershed Protection and Flood Prevention Act of August 4, 1954
- Sikes Act (Fish and Wildlife Conservation) of September 15, 1960
- Joint Surveys of Watershed Areas Act of September 5, 1962
- Land and Water Conservation Fund Act of September 3, 1964
- Federal Water Project Recreation Act of July 9, 1965

- Water Resources Planning Act of July 22, 1965
- Water Quality Improvement Act of April 3, 1970
- Clean Water Act of 1948 (as amended in 1972 (Federal Water Pollution Control Act) and 1987)
- Federal Land Policy and Management Act of October 21, 1976
- Surface Mining Control and Reclamation Act of August 3, 1977
- Soil and Water Resources Conservation Act of November 18, 1977
- Safe Drinking Water Amendments of November 18, 1977
- Emergency Flood Prevention (Agricultural Credit Act) Act of August 4, 1978
- North American Wetland Conservation Act of 1989
- 33 CFR 323 Permits for Discharges of Dredged or Fill Material into Waters of the United States
- 40 CFR 121-135 Water Programs
- EO 11988 Floodplain Management, 1977
- EO 11990 Protection of Wetlands, 1977
- FSM 2500 – Watershed and Air Management
- FSH 2500 – Watershed and Air Management

Vegetation

- Weeks Law of 1911, as amended (at 16 U.S.C. 515, 552)
- Knutson-Vandenberg Act of 1930 (16 U.S.C. at 576b)
- Anderson-Mansfield Reforestation and Revegetation Joint Resolution Act of 1949 (at 16 U.S.C. 581j and 581 j(note))
- Granger-Thye Act of 1950 (16 U.S.C. at 580g-h)
- Surface Resources Act of 1955 (30 U.S.C. 611-614)
- Healthy Forests Restoration Act (HFRA) of 2003 (16 U.S.C. at 1611-6591)
- Stewardship End Result Contracting Projects (16 U.S.C. 2104 (note))
- Tribal Forest Protection Act of 2004 (P.L. 108-278, 118 Stat. 868; 25 U.S.C. 3115a)
- Omnibus Public Land Management Act of 2009 (Title IV – Forest Landscape Restoration of PL 111-11)
- Collaborative Forest Landscape Restoration Act (CFLRA) of 2009
- National Forest Resource Management: Forest Service Manual (FSM) 2000—Chapter 2020—Ecological Restoration and Resilience
- Silvicultural Practices Handbook (FSH 2409.17), Silvicultural Examination and Prescription Handbook (FSH 2409.26d)

Fire Ecology

- Federal Wildland Fire Policy of 1995 (Updated in 2001)

- Guidance for Implementation of Federal Wildland Fire Management Policy, February 2009
- Federal Land Assistance, Management and Enhancement (FLAME) Act of 2009
- FSM 5100

Air Quality

- Clean Air Act (CAA), as amended 1977 and 1990
- 40 CFR 51 300-308 Federal Regional Haze Rule
- National Ambient Air Quality Standards (NAAQS)

Terrestrial Wildlife and Plants

- Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), as amended
- Bald and Golden Eagle Protection Act of 1940, as amended
- Migratory Bird Treaty Act of 1918 (as amended)
- Executive Order 13186 (migratory birds)
- FSM and FSH, Chapters 2620 and 2670
- FSM Chapter 2070, Regional Native Plant Policies

Aquatic Species and Habitat

- Endangered Species Act of 1973
- Clean Water Act of 1948 (as amended in 1972 (Federal Water Pollution Control Act) and 1987)
- FSM 2600 re: fish and wildlife management
- FSH 2600 re: fish and wildlife management
- Executive Order 12898 Environmental Justice, February 11, 1994
- Executive Order 13112 Invasive Species, February 3, 1999

Noxious or Invasive Weeds

- Environmental Justice, EO 12898 of February 11, 1994
- Invasive Species, EO 13112 of February 3, 1999 and amendment EO 13751 of December 2016, Safe guarding the Nation from the Impacts of Invasive Species.
- FSM 2370 (Special Recreation Designations), Part 2672 (Areas Designated Administratively) (RNAs and Botanical Areas) and Forest Service Manual, FSM 2372, 2372. 01, 2372. 02 and 2372. 05
- FSM 2620, 2630, 2670, 2672 re: sensitive species
- FSMs 2900 and 2150 and Regional Supplement No. 2100-98-1, re: noxious weed control
- FSMs 2080 and 2150 and Regional Supplement No. 2100-98-1 re: noxious weed management

Heritage Resources/Tribal Interests

- National Historic Preservation Act of 1966 (NHPA), as amended (16 U.S.C. 470), and its implementing regulation 36 CFR 800
- Indian Financing Act of 1974
- Cooperative Funds and Deposits Act of 1975
- Forest and Rangeland Renewable Resources Research Act of 1978
- Archaeological Resources Protection Act of 1979 (ARPA), as amended (16 U.S.C. 47Oaa et seq.), as implemented by 36 CFR part 296
- American Indian Religious Freedom Act (AIRFA)
- Federal Technology Transfer Act of 1986
- Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), as amended (25 U.S.C. 3001), as implemented by 43 CFR Part 10, Subpart B—Human Remains, Funerary Objects, Sacred Objects, or Objects of Cultural Patrimony From Federal or Tribal Lands
- Department of Interior, Environment, and Related Agencies Appropriations Act of 1992
- The Religious Freedom Restoration Act of 1993 (RFRA)
- Tribal Forest Protection Act of 2004 (TFPA)
- Culture and Heritage Cooperative Authority of 2008 (CHCA)
- Wyden Amendment (Public Law 109-54, Section 434)
- Executive Orders 11593 (Protection of the Cultural Environment), 13007 (Indian Sacred Sites), 13175 (Tribal Consultations), and 13287 (Preserve America).
- Programmatic Agreement (PA) between the Southwestern Region of the Forest Service; the Arizona, New Mexico, Texas, and Oklahoma State Historic Preservation Offices; and the Advisory Council on Historic Preservation (USDA 2003)
- FSM 2300, Chapter 2360, Heritage Program Management

Recreation and Scenery

- National Forest Roads and Trails Act of 1964
- Wilderness Act of 1964
- Wild and Scenic Rivers Act of 1968
- National Trails System Act of 1968 (16 USC 1241)
- Environmental Quality Act of 1970
- The Forest and Rangeland Renewable Resources Planning Act of 1974
- Federal Cave Resources Protection Act of 1988 (16 U.S.C. 4301–4309)
- FSH 1909.13.13a, Chapter 10 re: the Scenery Management System (SMS)
- FSH 1909.13.2.3; FSM 2380.61 re: landscape aesthetics guidance
- FSM 2310 re: use of Recreation Opportunity Spectrum

- FSM 2350 re: trail, river, and similar recreation opportunities
- FSM 2370 re: special recreation designations
- FSM 2380 re: managing landscape aesthetics and scenery

Socioeconomics

- Civil Rights Act of 1964
- Environmental Justice, EO 12898 of February 11, 1994

Lands and Minerals

- Act of 1866, General Mining Law
- An Act to Repeal Timber-Culture Laws, 1891
- Occupancy Permits Act (March 4, 1915)
- The Act of March 4, 1915, as amended July 28, 1956, (16 U.S.C. 497) authorizes term permits for structures or facilities on National Forest System land
- Bankhead-Jones Farm Tenant Act of 1937, Section 31-33
- Highway Act of August 27, 1958, (23 U.S.C. 317), supplemented by the Act of October 15, 1966 (49 U.S.C. 1651)
- Land and Water Conservation Fund Act of September 3, 1964
- National Forest Roads & Trails Act 1964
- Telecommunications Act of 1996 (Public Law 104-104)
- The Act of November 16, 1973, (30 U.S.C. 185) authorizes the Forest Service to issue authorizations for oil and gas pipelines and related facilities
- Mineral Leasing Act of 1920, as amended on November 16, 1973, (30 U.S.C. 185(1))
- Oil and Gas Pipeline amendment to the Mineral Leasing Act, Section 28
- Term Permit Act of March 4, 1915, amended July 28, 1956
- Federal Land Policy and Management Act of 1976
- National Forest Townsite Act of July 31, 1958 (72 Stat. 483; 7 U.S.C. 1012a; 16 U.S.C. 478a) as amended by Section 213 of the Federal Land Policy and Management Act of 1976 (90 Stat. 2760)
- Alaska National Interest Lands Conservation Act, 1980
- Small Tracts Act of January 12, 1983 (96 Stat. 2535; 16 U.S.C. 521c-i)
- Water Conveyance Act of 1986
- Colorado Ditch Act of 1986 (FLPMA amendment)
- Telecommunications Act of 1996 (Public Law 104-104)
- Forest Service Facilities Realignment Act of 2005 (119 Stat 559-563; 16 U.S.C. 580d, as amended).
- Energy Policy Act of 2005

- Executive Order 11990 (Wetlands) and Executive Order 11988 (Floodplains)
- Forest Service Handbook 2709.11 Special Uses Management
- Forest Service Manual 2700 Special Uses Management

Range

- Forest and Rangeland Renewable Resources Planning Act of 1974
- Federal Land Policy and Management Act of 1976
- National Forest Management Act of 1976
- 36 CFR 222: Subpart A – Graving and Livestock Use on the National Forest System, Subpart B – Management of Wild Free-roaming Horses and Burros, and Subpart C – Grazing Fees
- Forest Service Manual (FSM) 2200 – Range Management
- Forest Service Handbook (FSH) 2209.13 – Grazing Permit Administration Handbook

Transportation

- National Forest Roads and Trails Act of October 13, 1964, as amended (16 U.S.C. 532-538)
- Highway Safety Act of 1966 (23 U.S.C. 402)
- Organic Administration Act of 1897 (16 U.S.C. 551)
- Revegetation – Forest and Rangeland Renewable Resources Planning Act of 1974 (16 U.S.C. 1601, Pub. L. 93-378) as amended by the national Forest Management Act of 1976 (16 U.S.C. 1608, Pub. L. 94-588).
- Title 36, Code of Federal Regulations, Part 212 (36 CFR 212) re: administration of the forest transportation system
- Travel Management (36 CFR Part 212, Subpart A)
- Prohibitions (36 CFR Part 261, Subpart A) re: prohibitions on forest transportation system roads
- Sale and Disposal of National Forest System Timber (36 CFR Part 223 Subpart B) re: revegetation of temporary roads
- Forest Service Manual (FSM) 7700- Transportation System

Forest Plan Amendment Substantive Requirements

The proposed project-specific amendments discussed in detail in chapters one and two include several modifications to the current Tonto National Forest Plan standards and guidelines so new controls and technologies can be utilized where appropriate. The 2012 Planning Rule requires consideration of the applicable substantive requirements as described in 36 CFR 219.8 through 219.11 that are directly related to the plan direction being added, modified, or removed by the amendments (36 CFR 219.13). The responsible officials have determined the proposed amendments are directly related to the following substantive requirements:

§219.8 Sustainability

(a)(1)(vi) Ecological Sustainability, Ecosystem Integrity, Opportunities for Landscape Scale Restoration;

(a)(2)(i) Air, Soil, and Water, Air Quality;

(a)(2)(iii) Air, Soil, and Water, Water Quality;

(b)(2) Social and Economic Sustainability, Sustainable recreation; including…scenic character;

(b)(3) Social and Economic Sustainability, Multiple uses that contribute to local, regional, and national economies in a sustainable manner.

§219.9 Diversity of Plant and Animal Communities

(a)(1) Ecosystem Plan Components, Ecosystem Integrity;

(b)(1) Additional Species-Specific Plan Components, Provide the ecological conditions to contribute to the recovery of federally listed threatened and endangered species.

Evaluation of Substantive Requirements

The effects of the proposed amendments disclosed in this chapter, are the same as the effects analysis for the respective resources and substantive requirements related to the amendments, and were informed using the best available scientific information, scoping, effects analysis, monitoring data, or other rationale.

36 CFR 219.8 Sustainability (Ecological and Social/Economic)

Per 36 CFR 219.8, "a plan developed or revised under this part must provide for social, economic, and ecological sustainability within Forest Service authority and consistent with the inherent capability of the plan area…" Specifically, the activities that would be authorized by the amendments could potentially influence protections for:

a. ecological sustainability including ecosystem integrity to include structure, function, composition, and connectivity of terrestrial and aquatic ecosystems and watersheds; air quality; and water quality and resources.

The proposed modifications to the Tonto Forest Plan would not result in substantial adverse effects associated with the sustainability requirement nor would the proposed amendments substantially lessen protection for a specific resource or use associated with social, economic, or ecological sustainability. As a result, these plan amendments are consistent with the sustainability requirements at 36 CFR 219.8.

36 CFR 219.9 Diversity of Plant and Animal Communities

Per 36 CFR 219.9, "a plan developed or revised under this part must provide for the diversity of plant and animal communities, within Forest Service authority and consistent with the inherent capability of the plan area…" Additionally, the plan must support the persistence of most native species in the plan area. Specifically, the activities that would be authorized by the amendments could potentially influence protections for:

a. ecosystem plan components including ecosystem integrity of terrestrial and aquatic ecosystems and watersheds; and
b. species-specific plan components including providing for ecological conditions that contribute to the recovery of federally listed, proposed, and candidate species, and that contribute to the viability of species of conservation concern.

The project analysis includes consideration of substantial adverse impacts to, or substantially lessened protections for, federally listed, sensitive, management indicator, and other plant and animal species that may occur as a result of the amendments in accordance with 36 CFR 219.13(b)(6).

The proposed modifications to the Tonto Forest Plan would not result in substantial adverse impacts to plant and animal communities within the Rim Country Project area, including to those species of conservation concern. Nor would the proposed amendments substantially lessen protection for any plant and animal species. The proposed modifications to the Forest Plan support the persistence of native species in the Rim Country Project area. As a result, these plan amendments are consistent with the diversity of plant and animal communities as required by 36 CFR 219.9.

Watershed conditions, wildlife habitat, and timber are all resources as well as multiple uses that would be improved by the proposed modifications to the Tonto Forest Plan. Beneficial impacts to these resources would also improve the associated multiple uses. For example, by improving the watershed conditions and wildlife habitat, there would be increased opportunities for wildlife viewing, improved recreational uses, and sustainable ecosystems. Thinning treatments allowed as part of the proposed modifications to the Tonto Forest Plan could also contribute to traditional cultural uses, forest product industries, rangeland uses because access to such forest products or opening up stands would be desirable.

The proposed modifications to the Tonto Forest Plan to allow for mechanical treatments on steep slopes could alter recreation experience, particularly scenery, as a result of surface disturbance, smoke and charred vegetation from unplanned and prescribed fires, and long-term changes in vegetation structure and composition. The impacts to scenery and recreational settings would be localized and visible in both the short and long term. Impacts from smoke would be short term; these impacts would dissipate when fire activities cease. Resulting charred vegetation from fires would be visible in the long term. Scenic quality would be further impacted by the presence of activity slash and temporary roads and skid trails in the short term. These impacts would be reduced by natural vegetation regeneration and site rehabilitation in the long term. Changes to vegetation structure would have long-term, positive effects on scenic quality because improving forest health and resiliency also improves the recreation setting.

The proposed amendments would aid forest restoration efforts by allowing implementation of needed vegetation treatments across the project area, as opposed to treating smaller portions of the project area. While there would be short-term adverse impacts from the project, the resulting long-term benefits would be a sustainable, resilient forest ecosystem capable of supporting diverse plant and animal communities and multiple uses valued by local communities and visitors.

Assumptions and Methodology

To facilitate landscape analysis and strategic planning in the Southwest, the Forest Service has developed a framework of ecosystem types referred to as Ecological Response Units (ERUs). In the Southwestern Region of the Forest Service, these ERUs provide the foundational unit for analysis of vegetative attributes and associated ecosystem services at the landscape and strategic planning scales (USDAFS 2017). Reference conditions and desired conditions are described for each ERU. The desired conditions correspond with the final regional vegetation desired conditions that are carried forward in forest plans revised after this framework was developed. Of the three forest plans tiered to in the Rim Country EIS, only the 2018 Coconino Revised Forest Plan used ERUs. The 2015 Apache-Sitgreaves Revised Forest Plan used Potential Natural Vegetation Types (PNVTs) in its analysis, and the 1996 amended Tonto Forest Plan incorporated the earlier Terrestrial Ecological Unit Inventory (TEUI).

The forest cover types used for the Rim Country analysis are based on the Ecological Response Units (ERUs) identified in the project area. Ecological Response Units represent an ecosystem stratification based on vegetation characteristics that would occur when natural disturbance regimes and biological processes prevail (TNC 2006), and combine potential vegetation and historic fire regimes to form ecosystem classes useful for landscape assessment (USDA Forest Service 2014). Ecological Response Units are the next derivation based on the concepts developed for PNVTs. Ecological Response Units incorporate more information concerning fire and its role in the ecosystem. For the purposes of the Rim Country Project EIS analysis PNVTs and ERUs are considered equivalent and the term ERUs will be used throughout.

For some resource areas or at certain scales, the analysis presented may include classifications of forest cover types other than ERUs. For example, analysis of the effects of proposed treatments on vegetation at the fine- to mid-scale may discuss the existing vegetation type or existing condition (EC) in terms of cover types (e.g., ponderosa pine/Gambel cover type) that were derived from data collected as part of Common Stand Exams performed within the project area. Each resource area's section of Chapter 3 discusses the resource-specific assumptions and methodologies used for analysis, including cover types where relevant.

Each resource specialist determined what ecological units and subunits would be best to use for their effects analysis. Most specialists use watersheds as their landscape-scale analysis units, while the finer-scale analysis units differ by resource area. The analysis units used for each resource area are described in the Assumptions and Methodology section of each specialist report and summarized here for each individual resource area. Due to differences in specialists' approaches to rounding when displaying numerical data, sums of table columns may differ slightly from the totals displayed.

Effects Analysis

The Rim Country DEIS includes analysis of the potential direct, indirect, and cumulative effects from treating the number of acres proposed for each specific treatment toward its highest level of openness for that treatment (IT, SI, and UEA 10-25 at 25 percent; WUI and Infrastructure treatment at 7 percent. This level of examination is done to ensure that the maximum potential effects from the activities proposed in each action alternative are analyzed, even though it will give the appearance of more effects than expected. A stand treatment adjusted to a lower intensity during implementation, per the flexible toolbox approach used for this project, may have fewer effects on the environment, depending on the affected resource, than the more open treatments originally proposed for that stand, resulting in slightly different effects than those analyzed in the DEIS.

Cumulative Effects

A summary of past, present, and reasonably foreseeable projects with management activities proposed and completed (see Table 19), as well as past wildfires (see Table 20), in the Rim Country project area and in the 6th HUC watersheds is presented here. This summary is intended to provide a snapshot of those projects and events that have influenced the existing conditions of the project area (in terms of vegetation structure, composition, diversity and function). It also includes a summary of ongoing and reasonably foreseeable projects that may cumulatively affect project area resources. This summary represents the best available information made available to each resource specialist to determine relevancy to their specific resource. Each resource specialist identified the cumulative effects analysis boundary and past, present and reasonable foreseeable projects relevant to their specific resource and used this information, along with the potential direct and indirect effects, to analyze the cumulative effects on their resource area. Cumulative effects analyses are discussed in this chapter by resource area.

Table 19. Past, Current, and Reasonably Foreseeable Projects

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Vegetation Management Projects (Mechanical Thinning and Prescribed Fire)								
Mullen Saw timber and Whitcom Multiproduct Offerings	1990	Group selection, intermediate thin, pre-commercial thin, shelterwood seed cut	Mullen: 1,798/0/0 Whitcom: 1,440/0/0	0 /130/685 wildlife habitat improvement	Apache-Sitgreaves	YES	NO	NO
Jersey Horse Timber Sale	1991	Species habitat improvements, timber sales, forest vegetation improvements, fuel treatments	N/A	1,452/351/0	Apache-Sitgreaves	YES	NO	NO
Amended Elk Timber Sale	1993	Commercial and pre-commercial mechanical thinning	2,589/0/0	834/466/0	Apache-Sitgreaves	YES	NO	NO
Brookbank Multi-Product Timber Sale	1994	Mechanical thinning and prescribed fire	6,177/6,465/0	5,624/4,981/0	Apache-Sitgreaves	YES	NO	NO
Cottonwood Wash Ecosystem Management Area	1995	Mechanical thinning, fuelwood sales, prescribed fire	3,493/10,896/0	516/2,447/0	Apache-Sitgreaves	YES	NO	NO
Blue Ridge-Morgan	1997	Commercial mechanical thinning, fuelwood sales, broadcast burning	8,280/7,618/0	14,471/14,552/0	Apache-Sitgreaves	YES	NO	NO
Gentry	1997	Thinning, fire	7,718	451/191/0	Apache-Sitgreaves	YES	NO	NO

[5] Acres of implementation may be counted more than once for multiple activities on the same acres.

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Sundown Ecosystem Management Area	1997	Salvage cut intermediate treatment, regen, fire	7,607	2,075/24/170 range vegetation control, 1,830 range veg manipulation and type conversion, 3,463 tree encroachment control, 1,560 tree release and weed	Apache-Sitgreaves	YES	NO	NO
Wiggins Analysis Area	1998	Group selection, intermediate thinning, pre-commercial thinning, broadcast burning	5,935/3,385	0/4,224/0	Apache-Sitgreaves	YES	NO	NO
Show Low South (#22297)	1999	Prescribed fire, construction/ maintenance of defensible space	N/A	0/2,696/0	Apache-Sitgreaves	YES	NO	NO
Larson Rx Burn	2001	Prescribed fire	0/2,500/0	0/3,015/0	Apache-Sitgreaves	YES	NO	NO
Treatment of Dead Trees in the Rodeo-Chediski Fire (#20740)	2002	Treat dead trees for trail management, facility and road maintenance, utility line safety	N/A	5,730/1,880/15 fuels compaction	Apache-Sitgreaves	YES	NO	NO
Heber-Overgaard WUI	2003	Mechanical thinning, prescribed fire	3,593/489/0	5,089/686/571 fuels chipping, 541 range forage improvement, 96 special products removal	Apache-Sitgreaves	YES	NO	NO
Hidden Lake Rx Burn	2003	Prescribed fire	0/2,000/0	0/2,828/0	Apache-Sitgreaves	YES	NO	NO
Camp Tatiyee / Camp Grace Fuel Reduction	2004	Pile Burning	340/340/0	0/172/0	Apache-Sitgreaves	YES	NO	NO
Country Club Escape Route	2004	Commercial thinning, fire	0/975/0	524/1,848 burning/915 range cover manipulation	Apache-Sitgreaves	YES	NO	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
High Value Ponderosa Pine Tree Protection	2004	Mechanical thinning, insecticide treatment	698/0/698	985/826/203 insect control and prevention	Apache-Sitgreaves	YES	NO	NO
Rodeo-Chediski Fire Salvage	2004	Mechanical thinning, fuel treatments	47,467/0/0	25,913/626/1,256 fuel breaks, 411 planting/ regeneration site prep	Apache-Sitgreaves	YES	NO	NO
Forest Lakes WUI Treatment	2005	Mechanical thinning, hand thinning, piling, pile burning	N/A	1,691/1,645/0	Apache-Sitgreaves	YES	NO	NO
Rim Top Rx Burn (formerly Woods Canyon Fuel Treatment)	2005	Prescribed fire	0/665/0	0/665/0	Apache-Sitgreaves	YES	NO	NO
Show Low South (#4456)	2005	Thinning, fuels treatments	N/A	10/585/0	Apache-Sitgreaves	YES	NO	NO
Dye Thinning	2006	Mechanical thinning	250/250/0	247/0/0	Apache-Sitgreaves	YES	NO	NO
Hilltop WUI	2006	Mechanical thinning, mastication, prescribed fire	1,544/1,544/0	1,534/45/616 range forage improvement	Apache-Sitgreaves	YES	NO	NO
Bruno Thinning and Slash	2009	Hand thinning, piling, pile burning	0/86/0	0/70/0	Apache-Sitgreaves	YES	NO	NO
Whitcom WUI	2009	Commercial thinning, fire	0	925/0/0	Apache-Sitgreaves	YES	NO	NO
Hilltop II Fuels Reduction	2011	Mechanical thinning, prescribed fire	190/1,544/0	0/799/616 cultural site protection	Apache-Sitgreaves	YES	NO	NO
Little Springs WUI	2003	Group selection, improvement cut, commercial thin	7,991/0/0	4,376/4,227/ 2,500 range cover manipulation	Apache-Sitgreaves	NO	YES	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Nagel	2005	Commercial thin, salvage cut, fire	116,618	19,611/18,231/ 889 range cover manipulation, 1,592 range forage improvement, 321 scarify and seed landings	Apache-Sitgreaves	NO	YES	NO
Los Burros	2006	WUI thinning, hazardous fuels treatments, woodland stand thinning, thin from below, aspen regeneration treatments	22,224/3,560/0	30,237/13,059/ 29 range cover manipulation	Apache-Sitgreaves	NO	YES	NO
Nutrioso WUI	2006	Commercial thin, salvage cut, fire	28,576/39,356/0	19,476/9,870/ 827 tree planting, 394 control range vegetation, 33 control tree encroachment	Apache-Sitgreaves	NO	YES	NO
Show Low South (#29987)	2011	Commercial thin, group selection, fire	3,739/4,637/0	3,372/0/0	Apache-Sitgreaves	NO	YES	NO
Rodeo-Chediski Fire Rx Burn	2012	Fire, pruning, limbing	0/148,222/0	0/9,506/9,670 range cover manipulation, 5,162 weed & tree release	Apache-Sitgreaves	NO	YES	NO
Timber Mesa/Vernon WUI	2012	Single tree and group selection, commercial thinning, fire	27,000/as needed/0	18,781/39,760/ 9,911 range cover manipulation, 3,979 control tree encroachment, 6,551 weed & tree release	Apache-Sitgreaves	NO	YES	NO
Rim Lakes Forest Restoration	2013	Selection cut, broadcast burn	23,671/32,954/0	12,483/1,335/ 116 pruning, 6,251 range cover manipulation, 80 weed & tree release	Apache-Sitgreaves	NO	YES	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Larson Forest Restoration	2015	Group selection, intermediate thinning, pre-commercial thin, shelterwood seed cut, broadcast burn	25,726/4,906/0	1,867/0/2,513 range cover manipulation, 3 weed & tree release	Apache-Sitgreaves	NO	YES	NO
Upper Rocky Arroyo Restoration	2016	Mechanical thinning, hand thinning, fire	30,400/as needed/0	696/5,411/ 3,960 wildlife habitat improvement	Apache-Sitgreaves	NO	YES	NO
Section 31 Fuels Reduction	2017	Mechanical thinning	230/0/0	44/0/0	Apache-Sitgreaves	NO	YES	NO
Rodeo-Chediski Mastication (Heber-Overgaard and Ricochet/ Williams Ranch Fuels Reduction)	2018	Mastication, removal of small trees, piling & burning	285/285/0	0/0/0	Apache-Sitgreaves	NO	NO	YES
Pocket Baker	2000	Mechanical treatment, prescribed fire	5,200/17,000/0	0/5,450/0	Coconino	YES	NO	NO
Blue Ridge Urban Interface	2001	Pre-commercial thinning, prescribed fire	8,158/10,549/0	416/6,225/ 2325 control range vegetation	Coconino	YES	NO	NO
IMAX	2002		N/A	0/6,008/0	Coconino	YES	NO	NO
Pack Rat Salvage	2004	Salvage, thinning, pile burning	550/550/0		Coconino	YES	NO	NO
Bald Mesa Fuels Reduction	2005	Mechanical treatment, prescribed fire, fuels reduction	N/A	2,485/5,150/0	Coconino	YES	NO	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
APS Blue Ridge 69kV Transmission Line	2005	Mechanical treatment, prescribed fire	N/A	0/1,600/0	Coconino	YES	NO	NO
Good/Tule	2006	Thinning, prescribed fire	4,337/8,361/0	1,389/2,025/0	Coconino	YES	NO	NO
Post-Tornado Resource Protection and Recovery	2011	Removing downed wood, thinning	14,776/3,990/0	765/0/0	Coconino	YES	NO	NO
Lake Mary Road ROW Clearing (ADOT)	2016		N/A	788/0/0	Coconino	YES	NO	NO
Lake Mary Meadows Two Fuel Reduction	2005		N/A	117/10,223/ 803 control range vegetation	Coconino	NO	YES	NO
East Clear Creek Watershed Health Improvement	2006	Mechanical treatment, prescribed fire	10,407/10,497/0	40,020/38,470/ 30,000 weed & tree release, 10,000 control tree encroachment	Coconino	NO	YES	NO
Victorine 10K Area Analysis	2006	Mechanical thinning, prescribed fire	1,293/8,407/0	9,015/29,585/0	Coconino	NO	YES	NO
Upper Beaver Creek Watershed Fuel Reduction	2010	Mechanical thinning, prescribed fire	15,807/75,068/0	20,608/64,000/0	Coconino	NO	YES	NO
Blue Ridge Community Fire Risk Reduction	2012	Mechanical, pile burning	50-75/5/0	0/45,000/0	Coconino	NO	YES	NO
Clints Well Forest Restoration	2013	Mechanical thinning, prescribed fire	12,899/16,444/ 25 rock pit expansion	11/6,639/0	Coconino	NO	YES	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Hutch Mountain Communication Site	2017	Clearing for communication site and solar array, thinning	2.5/0/0	0.5/0/0	Coconino	NO	YES	NO
Cragin WPP	2018	Mechanical thinning, prescribed fire	41,046/63,656/0	0/0/0	Coconino	NO	NO	YES
Ridge Analysis Area	1994	Commercial thinning, salvage, vegetation improvements, hazardous fuels reduction	N/A	33,311/0/1,094 control range vegetation	Tonto	YES	NO	NO
Lion Analysis Area	2001	Intermediate thinning, prep cutting, uneven-aged management, wildlife forage areas, prescribed burning	2,455/9,000-10,000/0	5,664/6,900/ 664 weed & tree release	Tonto	YES	NO	NO
Verde WUI	2004	Thinning, PJ savanna restoration, fuel break construction, prescribed burning	15,471/28,438/1,401 PJ savanna restoration	10,648/48,500/ 5,000 range cover manipulation	Tonto	YES	NO	NO
Parallel Prescribed Burn	2014	Prescribed fire	0/24,089/0	0/4,759/0	Tonto	YES	NO	NO
Pine-Strawberry WUI	2006	Thinning, grassland restoration, fuel break construction, prescribed fire	9,709/40,928/ 7,525 grassland restoration	41,086/19,868/ 200 range cover manipulation	Tonto	NO	YES	NO

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Chamberlain Analysis Area	2008	Mechanical thinning, prescribed burning, shaded fuel breaks	8,072/20,050/0	9,044/19,000/ 1,675 control range vegetation	Tonto	NO	YES	NO
Christopher/Hunter WUI	2009	Thinning, fuel break construction, prescribed burning	32,358/20,550/0	10,763/19,000/ 450 weed & tree release, 489 control range vegetation	Tonto	NO	YES	NO
Cherry Prescribed Burn	2012	Prescribed burning	0/14,700 – 21,000/0	0/6,582/0	Tonto	NO	YES	NO
Myrtle WUI	2012	Fuel breaks, thinning, prescribed fire	16,702/27,131/0	103,891/75,800/1,091 weed & tree release, 744 control range vegetation	Tonto	NO	YES	NO
Flying V&H Prescribed Fire	Decision expected 2018	Prescribed burning, shaded fuel breaks	1,798/59,124/0	0/0/0	Tonto	NO	NO	YES
Haigler Fuels Analysis	?	Prescribed burning, shaded fuel breaks	43,435/43,435/0	0/0/0	Tonto	NO	NO	YES
Right-of-Way (ROW) Projects with Herbicide Use								
Management of Noxious Weeds and Hazardous Vegetation on State Highway ROWs	2004	Herbicide treatment of noxious weeds and hazardous vegetation	N/A	25/0/ 11,005 pesticide control of noxious or invasive weeds and hazardous vegetation	Tonto	YES	NO	NO
APS-Herbicide Use within Authorized Power Line ROWs on NFS Lands in AZ	Decision expected 2019	Herbicide treatment	0/0/ 2,136 herbicide application	0/0/0	Apache-Sitgreaves Coconino Tonto	NO	NO	YES

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
WAPA Glen Canyon-Rogers 230/345kV Integrated Vegetation Management	Decision expected 2019	Hazard tree removal, herbicide treatment, road repair	13,338/0/0	0/0/0	Coconino Tonto	NO	NO	YES
SRP-Herbicide Use within Authorized Power Line ROWs on NFS Lands in AZ	Decision expected 2018 or 2019	Herbicide treatment	0/0/ 7,469 herbicide application	0/0/0	Apache-Sitgreaves Tonto	NO	NO	YES
Wildlife Habitat Improvement, Grassland Restoration Projects/Allotment Projects								
Park Day Allotment	1994	Mechanical and hand thinning, fuelwood sales, broadcast burning	14,665/250/0	2,193/0/ 701 control range vegetation	Apache-Sitgreaves	YES	NO	NO
Clear Creek Allotment	2000	Species habitat improvement, rangeland vegetation improvement	108	2,397/0/ 949 control tree encroachment, 2,288 range cover manipulation	Apache-Sitgreaves	YES	NO	NO
Wallace Allotment	Unknown			0/0/ 1,586 control tree encroachment, 161 control understory vegetation	Apache-Sitgreaves	YES	NO	NO
Railroad Allotment (Formerly Carlisle Complex Vegetation Treatments)	2007	Mechanical juniper removal	10,000/0/0	2,873/0/ 561 control tree encroachment	Apache-Sitgreaves	NO	YES	NO
Heber Allotment		Mechanical thinning, prescribed fire	0/0/ 39,000 grassland restoration	0/0/0	Apache-Sitgreaves	NO	NO	YES

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Apache Maid Grassland Restoration	2004			54,528/6,770/0	Coconino	YES	NO	NO
Bar T Bar/Anderson Springs Allotment	2005	Meadow, grassland, wildlife corridor restoration treatment; prescribed fire	32,677/32,677/0	1,304/132,938/ 1,519 control range vegetation, 39,180 control tree encroachment, 652 wildlife habitat improvement	Coconino	NO	YES	NO
Flying V and Flying H Allotment		Juniper removal, seeding native grass, fence construction	10,875/0/ 112 fence construction	0/0/0	Tonto	NO	NO	YES
Hardscrabble Allotment Juniper Clearing		Cut juniper trees	100/0/0	0/0/0	Tonto	NO	NO	YES
New Delph Tank & Bear Tank Maintenance		Construct earthen stock tank, maintain existing tank	0/0/ 0.15 acres dredging and berm construction	0/0/0	Tonto	NO	NO	YES
Pleasant Valley Northwest Grazing Allotments		Fence construction, juniper removal	N/A	0/0/0	Tonto	NO	NO	YES
Red Lake Tanks		Tank construction, shrub removal	0/0/0.8 acres dredging, berm construction, ditch excavation	0/0/0	Tonto	NO	NO	YES
Reforestation/Planting Projects								
Bison Reforestation	2003	Site prep, planting	0/0/500	356/312/ 308 tree planting, 275 animal damage control	Apache-Sitgreaves	YES	NO	NO
Clay Springs Reforestation	2004	Site prep, planting	0/0/710	0/0/ 169 tree planting, 169 animal damage control	Apache-Sitgreaves	YES	NO	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Jacques Marsh Elk Proof Fence & Riparian Planting	2006	Exclosure, planting	0/0/10	0/73/0	Apache-Sitgreaves	YES	NO	NO
Pierce Reforestation	2009	Site prep, planting	0/0/1,375	0/0/ 203 tree planting, 203 animal damage control	Apache-Sitgreaves	YES	NO	NO
Rodeo-Chediski Riparian Planting	2010	Planting	0/0/ 1 tree planting	0/0/ 0.6 tree planting	Apache-Sitgreaves	YES	NO	NO
Rodeo-Chediski Reforestation (#18675)	2007	Planting, shade installation, fencing	0/0/3,071	0/150/ 551 tree planting, 303 animal damage control, 202 weed & tree release	Apache-Sitgreaves	NO	YES	NO
AGFD Fairchild Draw Elk Exclosure	2018	Maintain fence	0/0/ 16 fence maintenance	0/0/0	Apache-Sitgreaves	NO	NO	YES
Conifer Weeding for Aspen Enclosure	Unknown	N/A	N/A	65/0/0	Coconino	YES	NO	NO
Spring and Meadow Restoration Projects								
Bill Dick, Foster, and Jones Springs Enhancement	2013	Pond and trough installation, fence installation and maintenance, willow pole planting	0/0/9.3	Unknown	Coconino	YES	NO	NO
Long Valley Work Center Meadow Restoration	2018	Channel reconstruction, tree removal, pond removal, install erosion control matting		0/0/ 16 tree encroachment control	Coconino	NO	YES	NO
Mogollon Rim Spring Restoration Project	2018	Invasive weed removal, planting, install fencing, tree thinning	Unk/Unk/ 5 spring restoration		Coconino	NO	NO	YES

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
Other Projects								
ASNF - No NEPA docs found - various activities reported in FACTS but not tied to other named projects	Unknown	Tree planting and replanting, site prep, animal damage control, invasives control, control range vegetation, range cover manipulation, seeding and plating, tree encroachment control, weed & release, habitat improvement.	N/A	42,763/74,202/ 2,158 tree planting, 350 replant trees, 1,720 site prep, 59 animal damage control, 82 invasives control, 497 control range vegetation; 4,297 range cover manipulation, 438 seeding and planting, 5,563 control tree encroachment, 27 weed & tree release, 1,465 habitat improvement	Apache-Sitgreaves	NO	YES	NO
Four Springs Trail Realignment	Decision expected 2018	Trail reroute and rehabilitation	0/0/4.5 miles	0/0/0	Apache-Sitgreaves	NO	NO	YES
Heber-Overgaard Non-motorized Trail System		Creation of trail system		0/0/0	Apache-Sitgreaves	NO	NO	YES
Navopache Electric Cooperative Trunk Line Addition		Add new trunk line		0/0/0	Apache-Sitgreaves	NO	NO	YES
Grapevine Interconnect (Grapevine Canyon Wind Project)	2012	Installation of powerline and switchyard	24/0/0		Coconino	YES	NO	NO
APS Line Maintenance	Unknown			87/0/0	Coconino	YES	NO	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other[5]	Forest	Past	Current	Reasonably Foreseeable
COF - No NEPA docs found - various activities reported in FACTS but not tied to other named projects	Unknown	N/A	N/A	16,049/15,175/ 15 biocontrol of invasives, 20 pesticide control of invasives, 3,921 control range vegetation, 739 weed & tree release	Coconino	YES	NO	NO
Sixteen Rock Pits and Additional Reclamation	2017	Expansion and reclamation of rock pits	66/0/ 66 excavation, 5 re-contouring, 5 planting	0/0/0	Coconino	NO	YES	NO
Glen Canyon-Pinnacle Peak 345kV Transmission Line Vegetation Management (WAPA)	2014	Mechanical vegetation removal	4,580/0/0		Coconino	NO	YES	NO
TNF - No NEPA docs found - various activities reported in FACTS but not tied to other named projects	Unknown	N/A	N/A	15,565/26,386/ 260 tree planting, 198 tree re-planting, 4,018 pesticide control of invasives, 21,000 biocontrol of invasives, 6,890 range cover manipulation, 11,345 weed and tree release	Tonto	YES	NO	NO
Noxious Weed Treatment Projects	2005	Noxious weed treatment		61,015/1,008/ 2,021 pesticide control of invasives, 11 biocontrol of invasives	Tonto	NO	YES	NO
Cragin-Payson Water Pipeline and Treatment Plant	2012	Construct, operate, and maintain water transmission pipeline right-of-way	≤ 352/0/ ≤ 352 excavation, construction, and pipeline burial	0/0/0	Tonto	NO	NO	YES

Table 20. Wildfire History

Year	Acres
1943-1989	40,994
1990-1999	37,369
2000-2009	262,531
2010-2017	168,583
Total	**509,477**

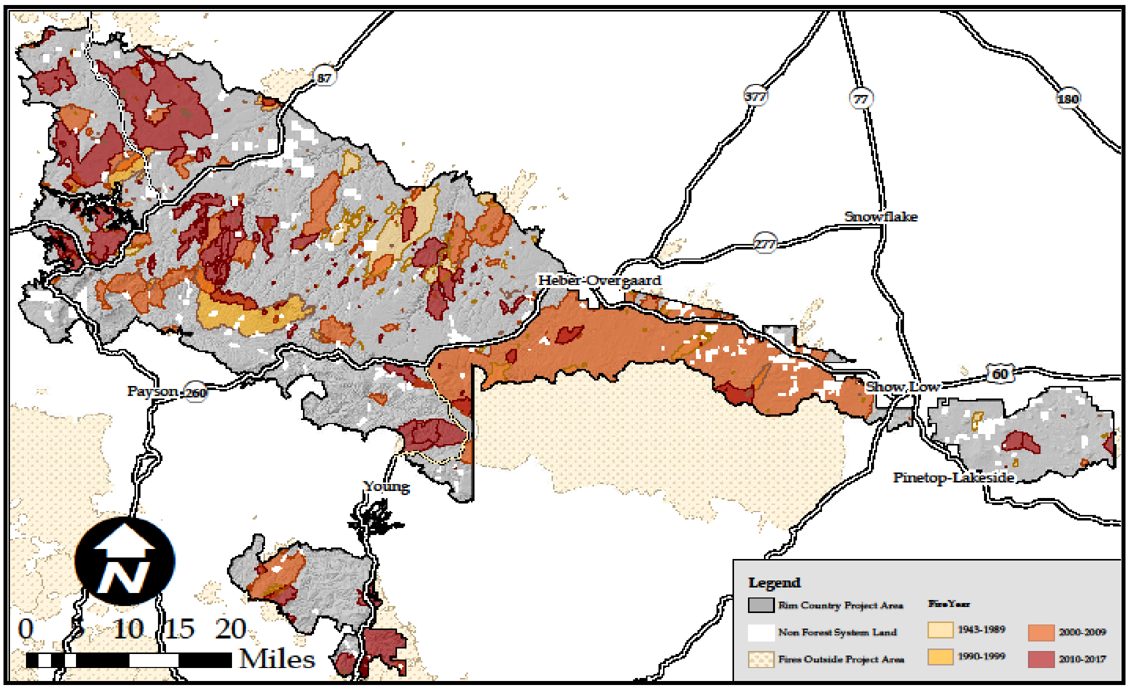


Figure 14. Wildfire history

Water and Riparian

The Water and Riparian Resource Report (Brown 2019) is incorporated by reference. See the specialist report for detailed information.

Affected Environment

Water Quality

Water quality of surface waters has been assessed on 113 miles of streams within the Tonto National Forest portion of the Rim Country project area, primarily within the Salt River and Verde River watersheds. Approximately 161 miles of surface waters have been assessed on the Apache-Sitgreaves and Coconino National Forest's portion of the project primarily within the Little Colorado watershed. In addition, 9 lakes totaling 739 acres were assessed within the Rim Country footprint. The specific water quality status of specific streams, rivers, and lakes that have been assessed by the Arizona Department of Environmental Quality (ADEQ, 2016) is available in the water and riparian resources report.

Within the Salt River and Verde River Basins, primarily on the Tonto National Forest, water quality is attaining all uses in 13.8 miles (12 percent), attaining some uses in 48 miles (42 percent), is inconclusive in 32.8 miles (29 percent) streams and is not attaining/impaired in 18.2 miles (16 percent) of assessed streams. Within the Little Colorado Basin, primarily on the Apache-Sitgreaves and Coconino National Forests, water quality is attaining some uses on 108 miles (67 percent) and inconclusive on 53.3 miles (33 percent) of assessed streams. In addition, nine lakes within the project area were assessed with two (totaling 149 acres) attaining some uses, four (totaling 387 acres) were inconclusive, one (111 acres) was not attaining some uses, and two (totaling 91 acres) were impaired.

The impaired lakes (Bear Canyon and Black Canyon) have a moderate priority for additional sampling that may indicate the need for initiating a total maximum daily load (TMDL) analysis to determine causative factors and to develop appropriate pollutant mitigation strategies. Some streams have had samples that exceed state water quality standards, however, most of the water bodies lack sufficient data to either remove or recommend impairment as there are state statutes dictating minimum data quality and quantity levels. The completion of a total maximum daily load assessment on impaired water bodies may result in developing additional water quality improvement strategies and mitigation of effects within associated watersheds.

The Upper Tonto Creek watershed includes stream reaches that are impaired for Nitrogen, Phosphorous, Low Dissolved Oxygen (D.O.), and E. coli. TMDL assessments were completed for Nitrogen and E. coli bacteria in 2006. Sources of contamination were identified as inadequate septic systems and recreational sources. ADEQ has approved Water Quality Improvement Grants (grants that allocate funds from the US EPA for implementing nonpoint source pollution control projects) for improving septic systems at R-Bar-C Boy Scout Camp (2007), Tonto Baptist Camp (2008), and to Gila County (2006). The Forest Service has constructed new bathrooms, restricted vehicle access to maintain a buffer for the creek, and converted portions of the area from overnight camping to day-use only. A TMDL for Phosphorous has not yet been scheduled and is identified as a low priority for development by ADEQ.

The Upper Tonto Creek watershed is identified as one of Arizona's Targeted Watersheds. These watersheds are a priority in the state for Clean Water Act (CWA) Section 319 Water Quality Improvement Grants and other strategies to restore and/or protect water quality conditions. Development of a TMDL for Low Dissolved Oxygen impairment in the Headwaters of Tonto Creek is identified as a low priority by ADEQ. (http://www.azdeq.gov/environ/water/assessment/download/Appendix_G_Priority_Ranking.pdf)

Implementation of site-specific Best Management Practices (BMPs) have been shown to be effective in mitigating impacts to water quality, and the development, implementation and monitoring of BMPs are Forest Service responsibility as described within the Memorandum of Understanding between the State of Arizona, Department of Environmental Quality and USFS Southwestern Region (USFS, 2013). The completion of a total maximum daily load assessment on impaired water bodies may result in developing additional water quality improvement strategies and mitigation of effects within associated watersheds.

Stream Courses

Stream courses within the project area are generally low-gradient ephemeral and intermittent streams with dendritic drainage patterns, except in areas with very steep terrain such as mountains (i.e., extinct volcanoes) and cinder cones, which typically have radial drainage patterns with high-gradient ephemeral and intermittent drainages flowing in all directions from upper slopes. Approximately 4,047 miles of occur within the analysis area, of which approximately 385 (10.5 percent) miles exhibit perennial flow.

Riparian and Stream Condition

In the Southwest, the Forest Service uses a system of ecosystem types, "ecological response units" (ERUs), to facilitate landscape analysis and strategic planning. ERUs have been built from plant associations and ecosystem units that have been identified through Terrestrial Ecological Unit Inventory (Wahlberg et. al. 2013). Within the project area, there are approximately 21,330 acres identified as riparian by the Region 3 ecological response unit ERU map (Treipke 2014a and b). Table 21 shows the percentages of each ERU within the project area. Of this total, the largest proportion consists of Narrowleaf Cottonwood/ Shrub with 35.6 percent, follow by Ponderosa Pine / Willow and Herbaceous (wetland) with 26.3 and 20.0 percent, respectively. Willow –Thinleaf Alder contributed 7.6 percent and each remaining unit comprised less than 5 percent of the total.

Table 21. Acres and Percent of Riparian ERUs

ERU	Acres	Proportion
Arizona Alder - Willow	228	1.1%
Arizona Walnut	68	0.3%
Fremont Cottonwood - Conifer	169	0.8%
Fremont Cottonwood / Shrub	539	2.5%
Herbaceous (wetland)	4270	20.0%
Historic Riparian - Residential/Urban	298	1.4%
Narrowleaf Cottonwood / Shrub	7584	35.6%
Ponderosa Pine / Willow	5607	26.3%
Sycamore - Fremont Cottonwood	946	4.4%
Willow - Thinleaf Alder	1617	7.6%
Total	**21,326**	**100%**

ERU – Ecological response units

The three forests surveyed riparian condition using different assessment methods. Therefore, for necessity of this analysis all the forest data was cross-walked into a single protocol for display and reporting. The protocol selected is the Proper Functioning Condition (PFC) (Dichard et al. 2015). Reaches meeting Proper Functioning Condition criteria are also in satisfactory riparian condition in terms of Forest Plan standards. Channel morphology (drainage configuration) is typically too variable in ephemeral reaches to allow applying any sort of standard or expectation.

Riparian condition was either documented or estimated on a total of 876 miles of intermittent and perennial streams since the late 1990's. A compilation of condition information across the three forest three forests within the project area is presented in the water and riparian resource report. A total of 257 miles (29 percent) were to be at PFC, with 475 miles (54 percent) at Functional at Risk and 145 miles (17 percent) rated nonfunctional.

The PFC summary data for the Tonto National Forest displays estimated riparian conditions developed during the Watershed Condition classification analysis completed in March 2011. Twenty four miles of riparian areas had been inventoried. The remaining stream channel condition classes were derived from gathering all existing riparian and stream information within each HUC12 watershed using the guidance found in the National Watershed Classification Technical Guide, Indicator #5 for Riparian/Wetland Vegetation Condition.

Wetlands and Springs

There are approximately 1,000 natural lakes, reservoirs, and natural wetland depressions within the project boundary that impound water for a sufficient duration to exhibit some wetland characteristics and are therefore listed in the U.S. Fish and Wildlife Service National Wetlands Inventory database.

Approximately 360 springs have been inventoried by the Spring Stewardship Institute within the Rim Country Project analysis area. Of these 360 springs, 214 have survey information, 138 are unverified, and 8 were verified. Information regarding historic flow or water quality from these springs is minimal. Most springs within the project area are either rheocrene- meaning they flow directly from the ground resulting in a small stream, helocrene- they emerge from low gradient wetlands, or hillslope – they emerge from confined or unconfined aquifers on a hillslope (typically 30 to 60 degrees); often with indistinct or multiple sources.

Several springs within the project area are currently being assessed using the Spring Ecosystem Assessment Protocol (SEAP) (Stevens et al. 2011) with at least one objective being that to see document effects of thinning treatments, such as those proposed by landscape- level restoration efforts like the Rim Country Project, on spring discharge. Eighty springs have been assessed using the SEAP protocol within the Rim Country project boundary. All these assessed springs are located on the Coconino National Forest. Eight percent of the springs were identified to be at moderate or greater risk. Many springs within the project area have been adversely affected by human activities including flow regulation through installation of spring boxes and piping of discharge to off-site locations, recreational impacts, urbanization and other construction activities, and grazing by domestic livestock and wildlife herbivores.

Watersheds and Watershed Condition

The Rim Country Project lies within 141 sixth-level, or 12-digit, hydrologic units (i.e., sub-watersheds), 28 10-digit (watersheds) and 11 eight-digit (sub-basins).

A watershed condition assessment was initially completed in 2011 for all sub-watersheds in the project area as part of an agency-level assessment of watershed conditions for each forest Watershed condition information is also included in the Soil and Watershed Specialist's Report. Some of the sub-watersheds have very limited areal extent within the project and will not be analyzed further in detail.

The result of the analysis of all watersheds in the project area indicate 20 (15 percent) were rated as Functioning Properly, 111 (83 percent) were rated as Functioning at Risk, and 2 (2 percent) were rated as Impaired. This information is presented in appendix B of the Water and Riparian Specialist Report (Brown 2019).

Watersheds that are identified as Class 2 or 3 (Functioning-at-risk or Impaired rating) are a result of, in large part, overly dense forests with fire regime condition classes of 2 or 3 (moderately or highly departed from reference conditions), a high-density road network that can alter hydrology with many in close proximity to stream courses, a riparian condition rating (PFC) of Functioning-at-risk and Non-functioning condition, and lack of native fisheries or aquatic species in watersheds with perennial streams. Current conditions are dominated by overly dense forests that lead to high fuel loads with the potential of uncharacteristic wildfires. Uncharacteristic wildfires in many cases result in soils with high burn severities that pose risk to watershed function, soil productivity, and water quality following storm events. High burn severity results in water-repellent soils, loss of protective vegetative ground cover and, following storm events, accelerated erosion and sediment delivery to connected stream courses that may degrade water quality. Consequently, accelerated erosion and sediment delivery into connected stream courses leads to loss of soil productivity and watershed function.

The distribution of ratings for these indicators related to water and riparian resources in the Rim Country project area are displayed in Table 22. Overall, ratings indicate that water quality was the highest of the three indicators, with 70 percent of watershed at a good rating. This is followed by 48 percent of the water quality ratings as Good. Riparian/Wetland condition was the lowest with most ratings at 'Fair' condition and a greater percentage of 'Poor' ratings than 'Good'. This suggests that the Riparian /Wetland indicator is most departed from desired conditions and is critical to address for restoration.

Table 22. Distribution of ratings for water quality, water quantity, and riparian/wetland condition indicators within Rim Country

Indicator	Poor	Fair	Good
Riparian/Wetland Condition	27%	58%	15%
Water Quality Condition	6%	23%	70%
Water Quantity Condition	15%	37%	48%

Environmental Consequences

Water Quality

The indicators for water quality includes acres of vegetation (forest, woodland, grassland, riparian) restored by mechanical and prescribed burning, the number of miles of stream channel and number of springs proposed for restoration, the changes in road miles and unauthorized routes, and overall projected changes to water quality, most importantly potential changes with compliance with the Clean Water Act.

Water quality in Arizona is reassessed and reported every 2 to 3 years by the State of Arizona. The latest assessment was documented in the Department of Environmental Quality in 2016 Clean Water Act Assessment (July 1, 2010 to June 30th, 2015) (ADEQ 2016). The findings and recommendations of the report are summarized in the affected environment section.

Most adverse effects on these resources can be minimized or mitigated through appropriate use of resource protection measures such as Soil and Water Conservation Practices (SWCPs) and Best Management Practices (BMPs) as outlined in the Soil and Watershed Conservation Practices Handbook (Forest Service Handbook 2509.22) (USDA 1990). These resource protection measures for the Rim Country Project are included as design features in appendix C. This project will incorporate BMPs, both general and site specific, designed to protect water quality. A memorandum of understanding with the State of Arizona and USDA Forest Service, Region 3 (USDAFS/ADEQ 2013) states 'Ensure that all project work schedules for project implementation on the ground contain site-specific BMPs, developed through the LRMP implementation process and consider technical, economical, and institutional feasibility and water quality impacts from the proposed activity in selection of the BMP. Monitor BMPs on selective activities to ensure they are implemented and are effective, adjust as necessary.' An important BMP feature is the Aquatic Management Zone (AMZ), which is an area adjacent to a waterbody where activity is restricted or limited to project aquatic and riparian values at risk. The proposed AMZ widths are outlined in the Rim Country design features.

Water Quantity

Water quantity is discussed in terms of stable hydrologic regime, persistence of flow, peak flows, and discharge to waterbodies and springs. Surrogates to analyzing these indicators are similar to those for water quality and include: acres of vegetation treated by mechanical treatments and prescribed burning, miles of roads opened and temporary constructed roads, decommissioned roads and unauthorized routes, and acres of rock pits and in-woods processing areas.

Riparian Resources

The indicators used to assess riparian include the miles of stream restoration, the number of springs proposed for restoration, and the number of acres proposed for vegetation treatments such as mechanical treatments and prescribed burning, including most importantly riparian and wetland areas. Other indicators include the miles of temporary roads constructed and Forest Service system roads reopened, the miles of Forest Service roads and unauthorized routes decommissioned. These are surrogates for assessing potential changes to resource conditions.

The Spring Stewardship Institute provided a spring inventory geodatabase for the project area, including Spring Ecosystem Assessment (SEAP) results for many springs.

Cumulative Effects and the Watershed Condition Framework

As mentioned previously, although all Watershed Condition Framework indicators are interrelated to some degree. Specific indicators such as Water Quality, Water Quantity, and Riparian/Wetland Vegetation condition were used to evaluate watershed-scale cumulative effects for water and riparian resources. Other Watershed Condition Framework indicators are addressed in the Soils and Watershed specialist report (MacDonald 2019).

Alternative 1

There would be no direct effects on water and riparian resources as a result of the no action alternative, however there would be indirect effects by not be moving these resources towards desired conditions. Overstocked and dense stands within the project area would not be treated, leaving a less healthy, less vigorous, and under productive forest. Risk of uncharacteristic wildfire would not be reduced. No improvement would be realized in woodlands, savanna, and grassland vegetation types where ground cover conditions are departed from desired conditions. No road decommissioning, rehabilitation of unauthorized routes or stream crossings would occur improving water quality. Stream, wetland, riparian, and spring restoration would not be completed at the scale intended for this project. The project area would not move toward desired conditions, as outlined in the Apache-Sitgreaves, Coconino, and Tonto Forest Plans.

Water Quality and Quantity

Absence of Mechanical Treatments and Prescribed Fire

It is likely that under any conditions, a wildfire entering these untreated watersheds under the no action alternative would have considerably greater impacts to water quality and channel stability than wildfire occurring after implementation of the action alternatives. Increased water turbidity, and downstream flooding would be more widespread in an uncontrolled wildfire situation than under prescribed fire conditions where the size and intensity of the fire can be controlled. Increased sediment loads are the primary physical impacts to surface waters following fire. The bulking effect of sediment and ash in runoff increases the risk to surface water impoundments, infiltration basins, and public water treatment systems. Sediment and debris flows can damage water supply infrastructure. Sedimentation of impoundments can decrease their effective life, resulting in a need for dredging and other mitigation measures.

Soils with erosion rates that are exceeding tolerance thresholds would likely continue to erode at current rates. Sediment delivery to streamcourses and waterbodies could continue at current rates or gradually increase from poor upland conditions. In areas where overstory densities are high, little long-term improvement in hydrologic flow regime will occur without mechanical treatment and/or prescribed fire. The soils in these areas have reduced moisture storage and infiltration capacity and are frequently overwhelmed by high intensity summer precipitation events, producing runoff events with relatively large peak flows of short duration. In areas that are overstocked with trees and encroached, water quantity would continue to decline as less water would be available for stream flows due to the closing of the overstory.

Absence of Riparian, Stream, and Upland Improvements

Riparian vegetation provides many water quality maintenance functions such as reducing surface water temperatures, which promotes high dissolved-oxygen concentrations, by blocking solar radiation. Stabilizing roots reduce the amount of bank cutting and erosion. Uptake by riparian vegetation can effectively remove excess nutrients and pollutants from water. Several stream reaches within the Rim Country Project area are experiencing increased water flows and sediment delivery from the effects of poor upland conditions, some of which are the result of several fires which have occurred over the past 20 years, most notably the Rodeo-Chediski Fire of 2002. These increased flows are causing stream instabilities both vertically and laterally. Stabilizing riparian vegetation has been scoured away causing detachment and movement of channel and bank material impacting sediment concentrations in water bodies. Without active stabilization activities water quality will likely not improve as quickly as with the action alternatives.

Absence of Roads Activities

This alternative is not anticipated to produce any changes to existing water quality trends in the streams, springs and surface water bodies in or downstream of the project area. Open roads and unauthorized routes being used for motorized travel will continue to discharge runoff and sediment to project area streams, especially where the roads are poorly located in stream bottoms, have inadequate drainage structure, and are hydrologically connected to the stream network (USDA 2010, Orndorff 2017, Berg 1988, Lousier 1990).

The short-term inputs of sediment into waterbodies caused by disturbance associated with the action alternatives would not occur.

Absence of Rock Pits and In-woods Processing Sites

The no action alternative would have slightly more potential of increased sediment yield to downstream perennial waters than the action alternatives because of the use and improvements of Forest Service system roads associated with the rock pits. Increased sediment yield by itself does not constitute an impact on water quality because the sediments leaving the road would have to enter a water body in large enough quantities to cause a change in beneficial uses. Maintaining roads to appropriate standards would be more difficult in this alternative due to the higher haul costs of bringing in rock from elsewhere. Fewer miles of roads surfaced combined with an increase in miles driven compared to the other alternatives would result in continued water quality impacts.

Riparian and Wetland Resources

Absence of Mechanical Treatments and Prescribed Fire

Under the no action alternative and assuming the absence of wildfire, current trends in condition of riparian areas within the project area would be expected to continue. Riparian condition would not benefit from improving upland watershed conditions to desired conditions with mechanical and prescribed fire treatments. There would be no potential benefit from improvement of the hydrologic flow and altered sediment regime by restoring herbaceous ground cover. Fuel loading would remain high, thus there would be greater risk of high burn severity and subsequent flooding effects, which could negatively affect riparian condition. Tree density and canopy closure within the riparian areas would increase. Current levels of large woody debris would be available to the stream channel both from the riparian and adjacent upland zones. Areas where deciduous woody riparian vegetation is being shaded out by invading conifers would remain in that condition.

This alternative would result in riparian condition improvement at a slower rate than either of the action alternatives as there would be no direct reduction of conifer encroachment via mechanical and prescribed fire to increase the potential for expansion and vigor of riparian vegetation.

Absence of Riparian, Stream, and Upland Improvements

Many of the stream reaches accessed are not currently at desired conditions and are in less than proper functioning condition. Headcuts and other instabilities can adversely affect riparian vegetation by scouring away soils and stabilizing plants leading to channel entrenchment and subsequent lowering the water table. It is expected that riparian condition of these reaches would continue to decline or, if recovering, recover at a slower rate with the no action alternative than the action alternatives.

Absence of Roads Activities

Potential effects from construction of temporary roads and opening of closed Forest Service roads, such as increased runoff on disturbed soils and potential increased delivery of sediment to water bodies, would not occur with the no action alternative. Forest service roads and unauthorized roads will not be decommissioned or relocated, therefore resource degradation from these roads will continue, and the improvement to riparian condition will not occur.

Absence of Rock Pits and In-woods Processing Sites

The absence of rock pits and in woods processing sites would have no impact on riparian or wetland resources because of the location of these away from these resources. The no action alternative would result in no additional acres of ground disturbance from rock pits and in little to no potential of sediment generation distribution from in-woods processing sites.

Effects Common to Both Action Alternatives

Water Quality and Quantity

Upland Mechanical Vegetation and Prescribed Burning Treatments

Water Quality

Fire, including prescribed burning, 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 calcium, magnesium, and potassium are converted into oxides and accumulated in ash (DeBano et al. 1998). During precipitation events these compounds can be delivered to nearby waterbodies. However, the primary short-term risk to water quality from prescribed fire and mechanical vegetation treatments is from increased sediment input to water bodies from where ground cover has been reduced or eliminated. This risk of is greatest where treatment activities result in soil disturbance or complete removal of vegetative ground cover in close proximity to drainages. Such areas would include designated stream crossings, skid trails, log landings, installed firelines, and areas with higher soil burn severity.

As reported in the Soils and Watershed specialist report (MacDonald 2018), erosion potential is expected to increase on 10 to 15 percent of areas treated mechanically due to removal or displacement of ground cover. However, this erosion would be short term (1 to 5 years) and localized. In the long-term, these treatments will likely increase vegetative ground cover and decrease the potential for high severity fire and substantially more drastic effects from heavy fuel loading. As shown in erosion modeling results, sediment delivery following high to moderate soil burn severity areas is about twice that of low severity areas, which is the predominant severity class resulting from prescribed burning. Where uncharacteristic, or high-severity wildfires have occurred, 36 percent of the TES (Terrestrial Ecosystem Survey) strata exhibited erosion and sediment delivery rates above soil loss tolerance thresholds. Bringing these areas towards desired conditions will promote stability in hydrologic and sediment regimes.

Thinning of forest cover on soils currently characterized as unsatisfactory would improve those soils over the long-term by improving soil moisture and allowing greater sunlight penetration to the forest floor, resulting in an increase in forest understory of desired herbaceous species. Vegetative recovery following fuel reduction treatments is generally rapid, with erosion rates typically returning to pre-treatment levels within 1 to 2 years (Elliot 2000). The increased herbaceous vegetation would likely reduce soil erosion and associated sediment delivery rates by providing vegetative and litter ground cover. This cover would intercept rain before it can reach soil surfaces, and detach and entrain soil particles in runoff water, promoting long-term improvement in water quality.

Resource protection measures including BMPs (see design features) are included with this project to protect water quality are effective in preventing long-term degradation of water quality from sediment and point sources of contamination. The use of streamside buffer zones, referred to as aquatic management zones (AMZs) in this project, to increase filtration capacity, have been shown to be capable of reducing sediment entering waterways to non-significant levels (Rashin 2006).

Water Quantity

Departures from historical ranges of variability (HRVs) in vegetation and fire regimes have the potential for alteration of hydrologic regimes. Excessive overland flows can increase channel flow volume and velocity, causing channel erosion and increased deposition downstream. The proposed mechanical treatments and prescribed fire would move portions of the uplands toward desired conditions. The increase in vegetative grass component would improve the ability of the watershed to intercept and retain water inputs (precipitation and snow melt). Herbaceous ground cover, residual plant material, and plant vigor would increase surface roughness, reducing runoff velocities. Soil compaction would start to break up and additional organic material incorporate into the soil, allowing for reduced surface runoff, increased water infiltration, and moisture retention. Overall, these conditions could promote more stable hydrologic flow regimes.

Fuel reduction treatments in forested watersheds, including mechanical treatments and prescribed burning, can result in long-term increases in water yields either on-site or downstream (Brewer 2008; Bosch and Hewlet 1982; Troendle et al. 2003, 2007). Treatment prescriptions that cover most of the project area and remove greater than 20 percent of tree basal area would be needed to generate a detectable change in surface flows. Treatments prescribed in the action alternatives would include leaving groups of trees, which would allow more snow collection in openings and result in greater potential for on-site water storage and yield. This could provide longer periods of flow in intermittent streams within and downstream of the project area (Zou et al. 2009).

In drier ponderosa pine stands, increased yields of one-quarter to one inch would be realistic. In cases where there is a detectable hydrologic response to vegetative treatments, the observed response would be greatest in wet years and smallest or non-detectable in dry years.

Prescribed fires, when designed and used as a fuel reduction tool alone, are probably less likely to influence water yield than mechanical treatments or a combination of burning with mechanical treatments, because of the smaller reduction in basal area and lack of ground disturbance by heavy machinery.

Riparian, Wet Meadow, Spring, and Stream Restoration

Restoration activities described in the Aquatic and Watershed Flexible Toolbox Approach (AWFTA) could promote conditions for desirable water quality and quantity characteristics. Reducing trees encroachment on riparian areas would allow for decreased precipitation interception, improved infiltration and water storage. Riparian vegetation often acts as a mitigating influence on flooding. Riparian vegetation provides instream roughness via large woody debris as well as live vegetation along stream banks. This roughness can reduce stream velocities and dissipate stream energy, resulting in an increased stream stage. The spreading of water out onto a floodplain promotes water entering into storage, further dampens peak flows. Improving conditions in these areas would also promote resiliency during uncharacteristic wildfires, by reducing the potential for high severity burning. High severity burning in riparian areas can reduce shading causing increasing stream temperatures, and destroy stabilizing vegetation resulting in excessive erosion and sediment production.

Long-term water quality would benefit from promotion of soil and channel stability and establishment of riparian vegetation, with improved dissipation of stream energy, water storage, and more stable flow regimes. Riparian vegetation can also maintain cooler temperatures within water bodies by reducing the amount of solar radiation impinging on the water surface. Water quality improvements can also occur from nutrient uptake and storage by riparian vegetation.

Short-term effects to water quality and quantity would be mitigated from riparian, wet meadow, spring, and stream restoration activities, but not eliminated entirely with implementation of design features. BMPs related to riparian restoration that are protective measures for water quality and quantity include those associated with AMZs and spill prevention and remediation (see water quality and quantity BMPs for general mechanical and prescribed burning).

Roads Activities

Road management-related activities include: road improvements, temporary road construction, decommissioning of system roads and unauthorized routes, and improvement and relocation of system roads. Approximately 5,682 miles of roads currently in the forest system road network would be needed for the activities proposed in the action alternatives. Of this total mileage, 2,076 would be included from the re-opening of maintenance level 1 (ML1) roads. Temporary roads would also be constructed. It is important to note that not all the ML-1 roads will be opened or temporary roads constructed at the same time across the project area. Only those ML1 and temporary roads required for implementation in a certain area would be opened or constructed. These roads would be properly maintained during implementation and closed or decommissioned, following Forest Service policy and design features (see Transportation specialist Report (Rich 2019)), when they are no longer required for project activities.

Vehicle traffic associated with project implementation, 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). Runoff from road surfaces can detach and transport the fine material from road prisms and ditches. Road proximity and connectivity to drainages can strongly influence sediment delivery to watercourses and alter flow regimes in streams. Road and stream intersections are the primary locations where sediments are delivered to stream courses. Sediment production from roads diminishes over time after proper closure and non-use (Beschta 1978). Roads induce surface runoff and can alter subsurface flow on hillslopes, and this could affect the magnitude and timing of surface runoff.

No long-term effect on water quality and quantity is expected from the action alternatives with regards to the proposed road activities. In the short term, it is possible that sediment inputs to area watercourses would increase slightly from re-opened roads, constructed temporary roads, or improved roads in the project area. However, all opened roads and temporary roads would be closed and decommissioned, respectively, when they are no longer needed. Short-term effects on water quality would be minimized by employing design features for road decommissioning and rehabilitation, including BMPs which are effective in preventing sediment from reaching streams when strictly followed.

A total of approximately 800 miles of existing system roads and unauthorized roads would be decommissioned under both action alternatives. Road decommissioning would entail obliteration whereby road surfaces could be ripped and seeded or mulched, inside ditches filled, road prisms outsloped, culverts and fill materials removed, stream crossings re-contoured, unstable sidecast or cutslopes removed or stabilized, and entrances blocked to prevent future access. These activities would return unproductive acreage to a more stable, productive status over the long term by improving water infiltration, naturalizing water flow, increasing vegetative ground cover, and reducing erosion. Upon completion of road obliteration activities, long-term erosion rates for decommissioned roads would be expected to approach natural erosion rates. Rehabilitation or removal of roads offers benefits including reduced sedimentation and decreased peak flows.

Rock Pits and In-woods Processing Sites

Rock Pits

The action alternatives include the use of 10 existing rock pits on the Coconino National Forest and 11 existing rock pits on the Apache-Sitgreaves National Forests. Since each of the rock pits analyzed is required to be operated so that they have internal drainage, none of the proposed pits or expansion areas would result in sediment outside the boundary of the pit and there would be no direct effect on water bodies. The lower hauling costs associated with having more rock pits closer to activity areas, would result in more miles of roads with better surfacing. This would also limit effects on water quality from roads. Water quality would be expected to remain the same or improve because of the greater number of road miles surfaced and maintained.

The site selection criteria used for rock pits and expansions greatly reduce the potential for effects on waterbodies. Increased truck traffic would create some finer sediment on road surfaces and could increase sediment yield. The main concern with increased sediment yields would be from dust caused by the construction and use of the rock pits and facilities. However, increased sediment yield by itself does not constitute an effect on water quality because the sediments leaving the road would have to enter a water body and in large enough quantities to cause a change in the beneficial uses of that water body.

In-woods Processing Sites

Twelve processing and storage sites are proposed and analyzed for use in the Rim Country EIS, ranging in size from 4 to 21 acres. These sites were screened so as to be located outside of riparian areas and away from nearby streams where some of the most productive forest soils are found, as well as in relatively flat areas. The siting of processing sites in relatively flat areas would minimize the need for extensive site grading.

In order to facilitate the types of tasks and equipment that may be used at these sites, the sites would typically be required to be cleared and grubbed (i.e., vegetative cover and trees removed), resulting in displacement of top soil and exposure of subsoil. The operation of equipment on these sites would result in compaction of the soil, reducing the ability of soils to infiltrate water. Areas of exposed soil would have to be covered with aggregate to minimize erosion and facilitate use of the site. The aggregate surfacing would cover the surface soil where it is not graded and would protect soil productivity. Various permits would need to be obtained for fuel storage, industrial site use, and stormwater pollution prevention. These permits would help to minimize effects on soil productivity and function.

Aboveground fuel storage tanks would have to be manufactured, installed, and operated in accordance with federal, state, and local requirements. For example, a permit for installation of an aboveground storage tank would have to be obtained through the Arizona State Fire Marshall's Office. Additionally, the processing sites would likely be regulated as industrial sites subject to permitting under the Arizona Department of Environmental Quality's Multi-Sector General Permit program. This permit program requires that certain industrial facilities, including those involved in the types of activities that would likely occur at the processing sites, implement control measures and develop site-specific stormwater pollution prevention plans to comply with Arizona Pollutant Discharge Elimination System requirements. Among other things, the prevention plan would have to identify best management practices that minimize non-point source water pollution, including measures to minimize or prevent soil erosion and contamination.

Following completion of the use of processing sites and removal of all equipment and materials, site rehabilitation would be accomplished, including but not limited to removal of aggregate, restoration of pre-disturbance site grades, de-compaction of soil for seedbed preparation, tree planting, and seeding and mulching of the site with native grasses and forbs.

The selection for processing sites included the following criteria: flat uplands less than 5 percent slope; more than 200 feet from ephemeral and intermittent stream channels, more than 300 feet from meadows, springs and karst features. These selection criteria considerations, in addition to the Rim Country design features for these sites, should greatly reduce the potential for effects on waterbodies.

Riparian Resources

Upland Mechanical Vegetation and Prescribed Fire Treatments

Upland mechanical thinning and prescribed burning treatments should reduce the risks to riparian communities and ecosystem integrity from scorching, and damaging peak flows associated with uncharacteristic wildfire. The effects of wildfire and prescribed burning activities on riparian areas are highly dependent on position of fire within the watershed, proximity to riparian areas, and position relative to mainstream channel and tributaries (Dwire et al., 2016). In general, the hotter a watershed burns, the greater the extent of burning within riparian areas.

In addition, the reduction of canopy cover near riparian areas would stimulate the development of understory vegetation including deciduous woody riparian vegetation (e.g., aspens, willows and cottonwoods). Reductions in upland tree density and the long-term maintenance of open stands and forest openings should respond with increased stream flow, and overall water yield (Brewer, 2008), which in turn would provide longer periods of intermittent stream flow. Increased infiltration resulting from the vegetative treatments would move excess moisture into sub-surface storage and groundwater, resulting in a slower release of water. Higher-intensity thinning would likely have the greatest potential for groundwater recharge, and stream and spring discharge, by reducing evapotranspiration rates. Increased water availability would support riparian vegetation abundance and vigor, and for stream channels minimize channel bank and bed instability (Fisher et al. 2008). Overall, the long-term effects of these treatments would likely improve riparian, stream channel, wet meadow, and spring conditions and functionality more quickly than the no action alternative. Adherence to project design features would limit the extent and degree of effects from mechanical thinning and burning activities both in the uplands and riparian areas. Treatments in AMZs would be limited in scope, space, and time to achieve multiple resource management objectives.

Riparian, Wet Meadow, Spring and Stream Restoration

Thinning activities and prescribed burning activities targeted for riparian resources including in around streams, wet meadows, and springs will have effects similar to those described in the prior section on effects to riparian resources from upland mechanical vegetative and prescribed fire treatments. Leaving riparian areas untreated and with higher fuel loading, while treating fuel loading in the uplands can produce high fire severities in these areas (Dwire et al., 2016). These higher severities can reduce riparian vegetation abundance and diversity and take several decades to recovery to pre-fire conditions.

Treatments can also produce other desirable effects such as potentially more groundwater and surface water to be available to promote riparian vegetation abundance and vigor. As stated previously adherence to project design features would limit the extent and degree of effects from mechanical thinning and burning activities both in the uplands and riparian areas. Treatments in AMZs would be limited in scope, space, and time to achieve multiple resource management objectives.

Activities included in the Aquatics and Watershed Flexible Toolbox Approach (AWFTA) would directly improve riparian conditions and functionality associated with stream channels and banks with stabilization techniques, and intensive treatments that modify stream sinuosity, width/depth ratio, and gradient. Grade control structures are useful for reconnecting stream channel and floodplains, reducing degrading stream energy and aggrading entrenched systems. Vertical instabilities such as headcuts can adversely affect riparian vegetation by scouring away of plants and soils and lowering of the water table. Reduction of bank erosion would increase stream stability and moisture-holding capacity of hydric soils, improving conditions for riparian vegetation production. Degraded wet meadows could be restored by transplanting native herbaceous species and reposing steep banks.

Upland soil stabilization would be completed at sites where soil conditions are contributing to gully formation. Stabilization techniques would include hand or mechanical installation methods, depending on site needs, access, and other resource concerns. Native vegetation would be expected to reestablish in these areas soon after restoration activities are completed (approximately one to three years). Additional benefits would include reduced susceptibility of sites to invasion by noxious or invasive weeds with the increased native vegetation recruitment over time. In some areas, riparian vegetation production would be augmented with planting of riparian herbaceous and woody species appropriate to those locations. Protective barriers around riparian areas would reduce the browsing and trampling effects from large ungulates, since continued heavy to extreme use of woody species could limit plants' ability to regenerate (Winward 2000).

Roads Activities

Riparian areas, wetlands, stream channels, and springs would not be directly affected by temporary road construction as it is prohibited in or near these resources in the project design features. Additionally, indirect effects are expected to be minimal. Poorly located roads and unauthorized routes can degrade soil conditions and cause channel instabilities resulting in excess erosion and deposition which may affect riparian diversity, extent, and vigor. Decommissioning of Forest Service system roads and user-created roads could improve functionality of riparian areas, stream channels, wetlands, and springs.

Rock Pits and In-woods Processing Sites

The selection criteria of processing sites included the following: flat uplands less than 5 percent slope, more than 200 feet from ephemeral and intermittent stream channels, and more than 300 feet from meadows and springs. These considerations, in addition to other relevant design features, should greatly reduce the potential for effects on adjacent riparian resources.

Effects Unique to Each Action Alternative and Differences among Them

Water Quality and Quantity

General Mechanical and Prescribed Fire Treatments

Proposed mechanical vegetative and prescribed burning treatments acres differ between the action alternatives, 817,870 and 427,786 for Alternatives 2 and 3, respectively. This amounts to a 48 percent difference between alternatives. There is an even greater difference, 28 percent more, in proposed treatment acres in the savanna vegetation type for Alternative 2 as compared to with Alternative 2Prescribed fire only acres are also lower in Alternative 3, with 40,630 acres proposed as compared to 54,070 acres in Alternative 2, a 26 percent difference.

Short-term water quality effects would be less for Alternative 3 as compared to Alternative 2 because of the decreased potential for sediment reaching waterbodies from ground-disturbing activities associated with mechanical vegetation and prescribed burning treatments. However, in the long-term, Alternative 3 would likely result in decreased long-term water quality benefits from fewer upland treatment acres that are currently not meeting desired conditions being treated. Thus Alternative 3 would have less of a benefit to downstream aquatic and riparian area habitat. Overall however, both alternatives would maintain compliance with the Clean Water Act through strict adherence to design features.

Regarding water quantity, Alternative 2 with more treated acres, could promote increased water yield, more stable hydrologic flow regimes, and increased discharge downstream. Springs would likely receive more groundwater recharge, promoting increased surface discharge.

Road Activities

More miles of temporary roads would be needed for Alternative 2 because more acres are proposed for mechanical and prescribed fire treatments. Up to 330 or 170 miles are proposed for implementation of Alternatives 2 and 3, respectively; a 49 percent difference. In the short-term, a greater number of temporary roads over the project area will remove more vegetation, exposing and compacting more bare soil, potentially leading to increased concentrated flows and sediment delivery to waterbodies. It should be noted that a potential increase in the magnitude or duration of effects from a greater number of temporary roads will likely be spread over a larger geographical area, including many additional watersheds, thus in essence spreading out potential effects. Overall, the short-term effects of temporary roads in either action alternative will be minimized with the use of road erosion control design features. All temporary road footprints are to be rehabilitated to as natural condition as much as possible, thereby mitigating potential long-term effects.

Riparian and Wetland Resources

General Mechanical Treatments and Prescribed Fire Including Treatments in Savannas
The general effects of mechanical treatments and prescribed fire, including treatments in savannas, on riparian and wetland resources are described in the Effects Common to Both Action Alternatives section, and apply to this section. Acres of mechanical and fire treatments differ Alternatives 2 and 3, amounted to a 48 percent difference. The difference in mechanical treatment and burning in grassland and savanna vegetation types acres treated was 28 percent comparing Alternatives 2 to 3. Prescribed fire only acres between the action alternatives resulted in a 26 percent difference.

As these proposed treatments are primarily upland treatments, direct effects on riparian and wetland resources are not expected. With regards to indirect effects, the additional treatment acres proposed in Alternative 2 (48 percent more mechanical and prescribed fire, 26 percent more prescribed fire only) as compared with Alternative 3, would bring more acres towards desired conditions. Therefore, Alternative 2, will to a greater extent reduce the potential for riparian impairment caused by impaired upland watershed conditions. Alternative 2 would also to a greater proportional extent promote longer periods of intermittent stream flow and groundwater recharge available to spring systems by bringing upland tree densities and forest openings to desired conditions. This would in turn support riparian vegetation vigor and wetland functionality.

Road Activities
More miles of temporary roads are required for Alternative 2 because more acres are proposed for mechanical and prescribed fire treatments. Up to 330 are proposed for implementation of Alternatives 2, a 49 percent increase, as compared to Alternative 3 with proposed 170 miles. With fewer miles of temporary roads proposed, there is likely less potential for negative effects to riparian and wetland resources with Alternative 3. Poorly located and high road densities can concentrate surface flow potentially causing increased peak flows damaging to these resources. The potential effects of temporary roads on riparian, spring, and wetland resources will be minimized with strict adherence to project design features. Specific design features which include the use of aquatic management zones, would be employed to protect these sensitive areas in both action alternatives. No temporary roads are to be located in close proximity (as defined as the AMZ width) to these resources. When no longer required for treatments, temporary roads are to be decommissioned through obliteration, and road footprints rehabilitated as to be returned to as natural condition as possible. The number of miles of Forest Service managed roads would return to pre-implementation numbers or those determined through the travel management rule (TMR) process for each forest. Thus, changes in open road density would be temporary, most likely two years or less.

Cumulative Effects Analysis

Spatial and Temporal Boundaries and Relevant Activities
The spatial boundaries appropriate for cumulative effects analysis of water quality, water quantity, and riparian resources are watershed boundaries. Water and riparian resources are primarily located in bottom lands which are strongly influenced by runoff from the surrounding topography. Multiple land-use

changes and activities in the uplands and upstream areas have can have an additive (cumulative) effect to these resources. Using the subwatershed (HUC12) hydrologic unit is consistent with the USFS Watershed Condition Framework (WCF) (USDA Forest Service 2011), which has attributes specific to these indicators. Temporally effects include those activities up to 20 years in the past and into the future.

Cumulative effects to water quality, water quantity and riparian resources include effects associated with past, present (ongoing) activities and those that are reasonably foreseeable. Aerially speaking, by far most the largest types of past, present, and reasonably foreseeable activities, excluding grazing, involve mechanical vegetative and prescribed burning treatments. Other activities include reforestation, spring and meadow restoration, and noxious or invasive weed and vegetative management along transmission lines. Reasonably foreseeable activities include projects with completed NEPA (planned) that are to be implemented and those anticipated occur in the future. Some of the more relevant projects include mechanical thinning in the Cragin Watershed Protection Project, the Rodeo Chediski Mastication Project, and several large prescribed burning projects such as the Haigler Fuels Analysis. Several woodland, grassland, and spring restoration projects are also proposed in the Heber, Pleasant Valley, and Northwest Grazing Allotments analyses and the Mogollon Rim Spring Restoration Project. Other projects in the planning stage include the Apache-Sitgreaves National Forests Travel Management Rule (TMR) with an expected decision in 2020. The Tonto National Forest is also in the process of finishing a TMR EIS. Superimposed on these activities are the effects associated with this project alternatives.

Water Quality and Quantity

Alternative 1

Cumulatively, when considering the past, present, and reasonably foreseeable future activities, the no action alternative will have fewer short-term effects on water quality than the action alternatives. This is primarily because ground disturbing associated with mechanical vegetative treatment activities, prescribed burning, riparian and wetland restoration, and transportation activities associated would not occur.

Cumulative effects from current livestock grazing would continue under alternative 1 and includes minor, generally localized soil compaction, puddling, displacement and erosion from livestock trailing and in areas where animals congregate. Livestock trails make up a very small portion of the total project area. There are no anticipated changes to the 303d listed impaired waters from the magnitude cumulative effects under alternative 1.

Alternatives 2 and 3

Long-term, cumulative positive effects would likely occur with Alternative 2 more so than 3. On average, the proportional extent of vegetative treatments (which comprise by far the greatest extent of all project activities) within HUC12 subwatersheds will increase by approximately 38 and 27 percent, respectively, as compared to the no action alternative by implementation of Alternative 2 and 3. Sixty-seven percent of Rim Country subwatersheds could receive an increase of up to 25 percent additional coverage of vegetative treatments acres in alternative 2 as compared to alternative 3. Increased coverage ranging from 25 to 50 and 50 to 75 percent would occur in seventeen and eleven percent more subwatersheds, respectively in alternative 2 as compared to alternative 3. Increases ranging from 75 to 100 percent would occur in 5 percent additional subwatersheds in alternative 2.

In addition to the vegetative treatments, the activities associated with the aquatic and watershed flexible toolbox approach and proposed road decommissioning activities included in the action alternatives will have additive positive cumulative effects.

Moving upland and bottom lands (riparian and wetland areas) vegetative cover and composition further towards desired conditions would reduce the risk of undesirable loss of overstory and ground cover, while stimulating vigorous plant growth, promoting infiltration rates, reduced overland flow, thus promoting overall stable hydrologic and sediment regimes. Riparian and wetland restoration activities and transportation footprint reduction activities will further complement the upland treatments from other projects in the cumulative effects boundary in promoting the improvement of water quality and water quantity indicators.

The short-term past, present, and reasonably foreseeable activities coupled with the action alternative would have similar incremental, short-term effects from ground disturbing activities to riparian and wetland resources. In the long-term, the combination of restoration activities in the project action alternatives including but not limited to: stream and wetland stabilization, riparian planting and protection barriers, road obliteration, and upland vegetative treatments, and other similar activities in the cumulative effects boundary would bring these systems closer to desired conditions, thus promoting the improvement of the riparian indicator based on the WCF.

Summary

The WCF water quality, water quantity, and riparian indicator scores are expected to be maintained or improved with the of past, present, and reasonably foreseeable actions combined with the activities proposed in the action alternatives. Although future watershed restoration activities are expected to have long-term benefits to watershed condition, the intensity of coincidental watershed activities (too large a proportion of a given HUC12 subwatershed over too short a time) could potentially lead to negative effects, including unstable hydrologic and sediment delivery regimes, and subsequent impacts to riparian vegetation.

Soils

Affected Environment

This section provides information about the existing conditions of the affected environment for soils and watershed resources within the project area of about 1,240,000 (with potential restoration treatment area of 953,130 acres). It also includes an analysis of watershed conditions at the 6th Hydrologic Unit Code (HUC) level. This section establishes the baseline against which the decision maker and the public can compare the effects of all action alternatives.

Appendix A of the Soils and Watershed specialist report displays the Terrestrial Ecosystem Survey (TES) map unit stratification and soil interpretations based on similar soils properties and behavioral characteristics, vegetation communities and management risks, limitations and potentials. Appendix B of the Soils and Watershed specialist report displays the existing and desired conditions, need for change and potential management strategies in tabular format by TES map unit stratum.

Affected environment of riparian resources, water quality, and water quantity is analyzed in the Water and Riparian Resources Specialist Report (Brown, 2018).

There were 186 TES map units from the 3 forests that were aggregated into 30 landscape unit strata. Each stratum has similar soils properties, slopes, climate regimes and vegetation communities. These soils also have similar limitations, hazards, suitability for various management activities and production potentials. The strata were used in part to design treatments, analyze effects and are based on the potential plant community and capabilities of the soils.

Assumptions and Methodology

This section describes the methodology and analysis processes used to determine the environmental consequences to soils and watershed resources from implementing the alternatives. Environmental consequences will be described with qualitative and quantitative descriptions supported by past studies and relevant literature.

Analyses for environmental consequences to soils and watershed resources that may result from implementation of each alternative were conducted using information contained in the Terrestrial Ecosystem Survey of the Apache-Sitgreaves National Forest, Coconino National Forest and Tonto National Forest, the Watershed Condition Framework, Ecological Response Unit (ERU) inventory maps (Triepke et al., 2014a and b), Forest Land Management Plans, Arizona Department of Environmental Quality (ADEQ), information obtained from other resource specialists, other agency reports, available literature, and input from collaborators, cooperators, and stakeholders. Geospatial analysis was used to quantitatively and qualitatively assess soils and watershed conditions using Geographic Information Systems (GIS) data obtained from a variety of sources.

Soil and Water Resources Condition Indicators

For soil resources, the units of measure of effects to soil resources will be the acres and severity of ground disturbance from equipment use and acres subjected to high soil burn severity. Most adverse effects to soils and water resources can be minimized or mitigated through appropriate use of resource protection measures and design features such as Soil and Water Conservation Practices (SWCPs) and Best Management Practices (BMP’s) as outlined in Soil and Watershed Conservation Practices Handbook (Forest Service Handbook 2509.22) (USDA 1990), the National Core BMP Technical Guide (FS990a) (USDA 2012), and other relevant BMP guidance.

For water quality measures, no physical stream measurements will be taken to determine water quality. A narrative description will explain the effects to water quality by Alternatives.

Soils

Soils throughout the project area were mapped as part of the Terrestrial Ecosystem Survey (TES) of each forest. This information is available at the respective Forest Supervisor's Offices.

The TES follows National Cooperative Soil Survey Standards similar to Soil Surveys conducted by the Natural Resource Conservation Service (NRCS). The TES is the result of the systematic analysis, mapping, classification and interpretation of terrestrial ecosystems, also known as terrestrial ecological units that are delineated and numbered. A TES represents the combined influences of climate, soil and vegetation, and correlates these factors with soil temperature and moisture along an environmental gradient. It is an integrated survey and hierarchical with respect to classification levels and mapping intensities.

Interpretations based upon TES incorporate 1) soil physical and chemical properties, 2) climatic considerations, 3) topographic position and slope, 4) vegetation and anthropogenic influences as well as animal effects, 5) productive and successional potentials, and 6) geologic influences. As such the TES can form the ecological basis for describing existing conditions for resource areas including watershed, wildlife, fire, and timber.

Erosion Modeling

Erosion modeling was completed using the FSWEPP program ((Elliot, Hall and Scheele 2000) at https://forest.moscowfsl.wsu.edu/fswepp/) and with site specific data (climate, slope, soil surface texture, length to drainage, cover percentage, and rock content) to determine upland erosion and sedimentation into stream channels. Upland erosion and sedimentation into stream channels rates are estimated up to three years for prescribed burning and five years for wildfire scenarios. The WEPP model has been validated for use in the Southwest (i.e., Arizona and New Mexico) through research on hydrologic processes to predict responses of soils to disturbances (Bolton et al. 1991, Paige et al. 2003).

Watershed Condition Class and Prioritization Information

It is important to note that the condition class of a watershed integrates the effects of all activities within a watershed, including those of other landowners. The Watershed Condition Framework therefore provides an ideal mechanism for interpreting the cumulative effects of a multitude of management actions on soil and hydrologic function (USDA, 2011).

It is reasonable to expect that treatments resulting from implementation of the proposed action or other action alternatives would result in some short-term, localized negative effects due to soil disturbance caused by use of heavy machinery for mechanical forest restoration treatments (including commercial timber harvests), burning of piled woody debris, and broadcast prescribed fire (Debano 1998, Hungerford et al., 1991). These disturbances would also occur on soils where previously completed projects overlap proposed or future activities in watersheds across the project area, resulting in a cumulative effect to soils and watersheds. However, no long-term, cumulative adverse effects from ground disturbance caused by mechanical thinning or prescribed fire (compaction, topsoil displacement, extensive areas of high soil burn severity, etc.) are anticipated to occur at a severity or spatial extent to negatively affect overall soils and watershed conditions. In general, proposed restoration treatments are expected to result in improvement in overall soils and watershed condition in proportion to the areal extent of the restoration treatments within each watershed.

Environmental Consequences

This section describes the direct, indirect, and cumulative effects of implementing each alternative on the soil and water resources in the Rim Country Restoration Project analysis area. It presents the scientific and analytical basis for the comparison of the alternatives presented in Alternatives section and establishes the baseline against which the decision maker and the public can evaluate the effects of the action alternatives.

Alternative 1 – No Action

The No Action Alternative would result in no changes to current rates of vegetation management, commercial timber harvesting, pre-commercial vegetation treatments, or other mechanical or non-mechanical fuels reduction treatments; no changes to road construction, maintenance, decommissioning or obliteration; and no changes to prescribed fire implementation or wildfires managed for multiple resource benefits within the Rim Country Restoration project area. These activities would continue at the current scale and rate. Planned projects (e.g., Cragin Watershed Protection Project, etc.) would be implemented in accordance with official decisions and available funding. Therefore, there would be no changes to current direct effects to soils, water quality, ephemeral or intermittent stream channels, or watershed condition as a result of the no-action alternative. Other proposed activities such as restoration of springs, riparian habitats, grasslands, and meadows would continue at current rates rather than the accelerated rate proposed in the action alternatives. These important landscape features and wildlife habitats would be expected to remain in degraded or impaired conditions for longer periods than under the action alternatives.

Due to the substantially extended temporal timeframe and reduced scale under which restoration actions would occur under the No Action alternative (i.e., individual projects rather than landscape-scale restoration), it is reasonable to expect that short term adverse effects to soils and watershed conditions that result from mechanical and prescribed fire treatments would also occur at a reduced rate and scale.

Absence of Upland Vegetation Treatments and Prescribed Fire

Since tree basal area or density reduction of currently overstocked stands within the project area would not occur at the same rate as under the action alternatives, increased fuel loading in both living biomass and woody detritus would be expected through natural forest ingrowth and tree encroachment into existing openings followed by forest decadence caused by intraspecific and interspecific competition. Additionally, forest ingrowth would continue to increase “ladder fuels” which allow ground fires to ascend and spread quickly as crown fires. Coarse woody debris would be expected to increase over time as small, medium, and large diameter material begins to fall to soil surfaces and decay. While these conditions may improve soil quality in some regards (organic matter accumulation in subsurface horizons, microhabitat for soil organisms and increased organism populations, increased water holding capacity) they would also result in an increased risk of high severity wildfires where fuel loading becomes excessive.

The location, size and severity of future wildfires cannot be estimated with accuracy, although some generalizations can be made. High severity wildfires tend to occur in areas where fuel loading and fuel distributions are sufficient to carry a fire. Typically, uncontrolled wildfires occur during the drier times of the year, yielding higher severity fires than would occur under prescribed fire conditions. The adverse effects of a high severity wildfire, such as the loss of forest floor organic matter, increased soil erosion and sediment delivery to waterbodies, and changes in soil habitat and biota would be more widespread in an uncontrolled wildfire than under prescribed fire conditions (DeLong et al., 2017, Spigel and Robichaud 2005). The primary effect of high severity wildfire on soil productivity is the removal of understory vegetative cover and surface organic matter (i.e., loss of protective cover and nutrient stores), exposure of soil surfaces to erosion by wind and water, and exposure of soils to solar radiation, which increases soil temperatures and reduces soil moisture. If surface organic matter is reduced (as happens under high-severity, long-duration fire) the cation exchange capacity of the soil is also reduced and the ability of the soils to retain nutrients leached from ash also decreases.

In the absence of mechanical vegetation and fuels treatments and prescribed fire, a high severity wildfire would very likely result in increased surface runoff and downstream flooding, soil erosion, and sediment delivery to streamcourses as a result of loss of effective ground cover at the soil surface, reduced rainfall interception, and reduced soil water infiltration rates. The infrequent nature of ephemeral stream flow results in the potential for sediment and ash to be stored within these stream channels and then transported during the larger surface runoff events. This, in turn, could pose detrimental effects to surface water quality and water storage capacity in livestock and wildlife waters.

This alternative would result in no additional acres of ground disturbance over current levels from tree felling, piling of activity-related woody debris, use of prescribed fire, temporary road construction, or expansion of gravel pits. Risk of uncharacteristic wildfire would not be reduced at the same rate as the action alternatives. No improvement would be realized in forested areas, woodlands, savannas, and grassland vegetative types where vegetative ground cover conditions are departed from desired conditions. No road decommissioning, or rehabilitation of unauthorized routes or stream crossings would occur above current levels. The project area would therefore not move toward desired conditions as outlined in the Apache -Sitgreaves, Coconino, and Tonto Forest Plans as rapidly as under the Action Alternatives.

The No Action alternative would not adequately contribute to reduced forest vegetation densities, desired fire regimes, and forested conditions that would provide resilience against uncharacteristic disturbances such as high severity wildfire, insect and disease outbreaks, and prolonged drought or climate change induced mortality. Currently 37 percent of the Rim Country project area has a fire hazard index of moderate or higher, which presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality. Four percent of the landscape is in the very high category (Fire Ecology and Air Quality Specialist Report). Under dense forested condition, litterfall has resulted in thick forest floor litter layers that have displaced native plant communities. These native plant communities provided greater benefits to watershed condition and soil hydrologic function than litter alone through improved fine root turnover rates, increased fine litter, improved soil porosity and aggregate stability, increased water holding capacity, and increased organic carbon sequestration.

The effects of high severity wildfires on soils, watershed condition, water quality and water quantity are well understood. High severity wildfires can cause damaging flows to streams resulting in high levels of sediment and ash inputs as well as increased risk to riparian areas and other downstream values at risk, including forest infrastructure. It is likely that under any conditions, a wildfire entering these untreated watersheds under the no action alternative would have considerably greater effects to soil productivity, water quality and channel stability than wildfire occurring after implementation of the action alternatives. Increased water turbidity, and downstream flooding would be more widespread in an uncontrolled wildfire situation than under prescribed fire conditions where the size and intensity of the fire can be controlled. The bulking effect of sediment, ash, and debris in runoff increases the risk to surface water impoundments, infiltration basins, and public water treatment systems. Sediment and debris flows can damage water supply infrastructure (Blandon et al., 2014). Sedimentation of impoundments can decrease their effective life, resulting in a need for dredging and other mitigation measures.

In areas of high stand densities, long-term improvement in hydrologic processes will not occur in the absence of mechanical treatment and/or prescribed fire. The soils in these areas have reduced moisture storage and infiltration capacity and are easily overwhelmed by high intensity summer monsoon precipitation events, producing runoff with relatively high peak flows of short duration.

Other potential detrimental effects to hydrologic conditions in the project area and downstream locations could include the destabilization of the geomorphic conditions of stream channels due to excessive sediment delivery and debris loading, increased peak flows, and overall increases in average annual water yield resulting from loss of upslope interception, infiltration, and evapotranspiration. Ephemeral stream channels within high burn severity areas would lose their ability to buffer runoff from large rainfall events, resulting in increased channel scour and incision caused by accelerated runoff and erosion from severely burned watershed areas. Increased bedloads in stream channels effectively raises the elevation of stream bottoms, causing flood flows to exceed channel capacities, resulting in overland flooding.

In the absence of vegetation treatments proposed in Alternative 2, including prescribed fire, approximately 953,130 acres of soils resources and watersheds would not be improved.

In the absence of vegetation treatments proposed in Alternative 3, including prescribed fire, approximately 529,060 acres of soils resources watersheds would not be improved.

Absence of Riparian Area, Wet Meadow and Stream Restoration Treatments

Watershed condition is dependent on the condition of the riparian communities that exist within the watershed. The benefits of riparian areas in the project area cannot be over emphasized. Riparian areas help capture pollutants including sediment and nutrients, contribute to channel stability by providing protective vegetative cover and root biomass that anchors soils, regulate water temperatures by providing shade, provide areas for floodwater storage and dissipation and are important wildlife habitat features. The increased flows have resulted in vertical and lateral channel instability in many intermittent and perennial stream reaches. Riparian vegetation has either been scoured away or reduced through increased channel incision that has detached riparian communities from adjacent floodplains. Stream channel substrates have been altered through increased runoff and in-channel transport. In the absence of proposed riparian, wet meadow, and stream restoration activities, watershed condition would not be improved on 21,280 acres of riparian areas, wet meadows and stream channels. As a result, these areas will continue to not meet desired conditions as outlined in Forest plans and existing risks to water quality would persist.

Absence of Road Decommissioning

Roads are a major contributor to surface water quality degradation and long term loss of soil productivity. Additionally, system (permanent) roads convert productive soils to a non-productive condition for the long term (typically greater than fifty years). They therefore constitute an irretrievable, but not irreversible commitment of resources. Irretrievable is a term that applies to the loss of production, harvest or use of natural resources. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of sue of nonrenewable resources, such as minerals or cultural resources, or those factors, such as soil productivity, that are renewable only over long periods of time. Since soil productivity can be restored through application of remedial measures such as disking, ripping, revegetating, etc., loss of soil productivity is not irreversible. However soil productivity is lost throughout the duration that a road exists on the landscape.

Under the No Action alternative, decommissioning of up to 200 miles of existing system roads on the Coconino and Apache-Sitgreaves National Forests, and up to 290 miles on the Tonto National Forest and 800 mile of unauthorized road would not occur. Based on an average width of 12 feet, there are approximately 1,877 acres of roads planned for decommissioning (713 acres of NFS system roads and 1,164 acres of unauthorized roads). These roads would remain on the landscape as unproductive sites and as chronic sources of sediment to streamcourses. Existing open roads and unauthorized routes would likely continue to be used for motorized travel and would remain as chronic sources of pollution, including sediment to stream channels throughout the Rim Country area, especially where the roads are poorly located in stream bottoms or hydrologically connected to streamcourses or have inadequate stormwater control or drainage.

Absence of Rock Pits and In Woods processing sites

Alternative 1 would have slightly more potential of increased sediment delivery to waterbodies than the action alternatives since road improvements proposed under the Action Alternatives would not occur. Selection of Alternative 1 would mean that road improvements would continue to occur at existing levels, which are currently insufficient to maintain road infrastructure adequately. Roads would therefore continue to serve as chronic sources of sediment to streamcourses and downstream waterbodies.

Expansion of rock pits under the Action Alternatives constitutes an irreversible and irretrievable commitment of resources since productive land is permanently altered and converted to an unproductive status and soils are permanently altered from their in situ condition through overburden removal and extraction of rock for road surfacing. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. Rock extraction limits future options for use of the converted sites and for of the material extracted. The No Action Alternative would mean that 66 acres of rock pit expansion would not occur, thereby eliminating this irreversible and irretrievable commitment of natural resources.

Alternative 1 would eliminate the need for 12 wood processing sites (128 acres). Activities such as drying, debarking, chipping stems and bark, processing and sorting logs to size, scaling and weighing logs and creating poles from suitable sized logs would therefore not occur. These sites constitute an irretrievable commitment of soils and vegetation resources since they remove soils and vegetation from productive status for several years while the sites exist. Selection of Alternative 1 would eliminate the need for this irretrievable commitment of soils and vegetation resources.

Effects Common to Both Action Alternatives

Upland Vegetation Treatments

Potential effects of the Action Alternatives on soil productivity would include localized soil compaction, puddling, displacement, erosion, loss of soil organic matter, short-term changes in soil moisture content or retention, changes in nutrient cycles, changes in soil fauna, and introduction of invasive and noxious weeds. These effects can result from both mechanical and non-mechanical vegetation treatments (i.e., forest thinning), mechanical and non-mechanical piling of activity-related debris, and road construction and maintenance activities necessary to support mechanical vegetation treatments. Mechanical forest vegetation treatments have the potential to adversely affect water quality through introduction of sediment and additional nutrients from decomposing woody debris, particularly where mechanical vegetation treatments occur in areas adjacent to stream courses.

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 landings prior to project implementation would minimize adverse effects to soil productivity caused by these activities.

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.

The risk of short-term accelerated soil erosion would be highest in areas where forest thinning and use of prescribed fire results in soil disturbance or complete removal of vegetative ground cover. These areas are expected to include skid trails, log landings, temporary access roads, obliterated roads, installed firelines and fuels treatment areas to support prescribed burning efforts, 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). 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 (for example, soil compaction which causes a shift from subsurface flow to overland flow) (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 (Robles et al. 2014, Cram et al. 2007).

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 (for example sunflecks) resulting in an increase in grasses, forbs and shrubs in the forest understory where litter is currently the dominant soil cover (Griffis et al., 2000). The increased herbaceous vegetation would reduce soil erosion rates by providing vegetative 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 (i.e., slash) would be lopped and scattered where doing so would not result in excessive fuel loads, further mitigating potential adverse effects to soils and watershed resources. Finer litter and woody debris that is incidental to forest vegetation treatments (i.e., 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

Prescribed fire has the potential to affect water quality by increasing sediment, dissolved solids, and nutrients in streams. 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, 1987). 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 accumulate in ash (DeBano et al. 1998).

The mobility and concentration of nutrients in soils determines whether or not 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(O'Donnell et al., 2014). 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-intensity prescribed fires, an increase in grasses and other herbaceous vegetation often occurs. This rapid regrowth of ground cover further immobilizes nutrients in plant material.

Prescribed fires that remove large amounts 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 throughout the Rim Country analysis 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 water can cause erosion problems and result in higher stream discharges. Fires not only consume portions of the litter layer, but at high temperatures fires can also cause hydrophobic soil conditions (water repellant soils), 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 (i.e. conditions that commonly occur during prescribed fire in the spring and fall), soil hydrophobicity was less pronounced and only occurred after long heating times which would typically only occur during smoldering fires. Therefore, soil hydrophobicity under a prescribed fire scenario would likely be minimal in most cases.

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 proposed under the action alternatives are expected to be dominantly low soil burn severity with small areas of medium and high soil burn 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. In general, low severity prescribed fire does not cause excessive erosion or sediment transport since some soil cover is retained in a discontinuous pattern across the landscape. This type of prescribed fire would not have a long-term adverse affect on soil moisture content or biota. The increase in understory vegetation 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.

Installation of firelines where they do not currently exist would expose soil surfaces, increasing the risk of erosion by both wind and rain. Areas of high severity fire may consume forest floor organic matter, leaving soil surfaces hydrophobic (repellant to water) and susceptible to erosion. Initially, the greatest risk of soil erosion would be expected to 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, higher stand densities and crown bulk densities at these locations, resulting in increased risk of high severity fire. Rehabilitation of firelines installed during prescribed burning would minimize adverse affects to soil productivity from fireline installation. 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.

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 pile burning is conducted. These areas would constitute a very small percentage of overall treatment area (10 to 15 percent), so these effects are expected to be minor. Use of appropriate design features and BMPs as outlined in Appendix F would mitigate most adverse effects from piling of woody debris created during forest thinning operations. Additionally, use of excavators with hydraulic bucket thumb attachments would minimize soil disturbance resulting from machine piling more effectively than dozer piling.

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, 2004). 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 very small portion of the project area (less than 10 percent). Employing piling techniques that would minimize soil burn severity (such as rack-and-pile technique) whereby the pile is elevated on a grid of logs would reduce soil of these 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, improved water holding capacity, lower bulk densities, and nutrient cycling. Initially, there would be an expected short-term increase in soil organic matter as a result of mechanical vegetation treatments as fine litter and woody debris are 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 as a result of forest thinning would decrease overall evapotranspiration rates from trees, but this is typically offset by increased evapotranspiation of understory herbaceous vegetation within a few years following treatment. Warmer soil temperatures 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 litterfall 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. Over time, a balance would occur between soil organism activity and soil organic matter content. This balance is readjusted whenever fire is reintroduced. Low severity fire typically results in beneficial relationships between soil organism populations and soil organic matter content.

Runoff from road surfaces can detach and transport the fine material from road prisms and ditches. Sediment delivery directly from road surfaces to water courses is difficult to estimate since it occurs as non-point 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.

Temporary Road Construction and Road Improvements

Temporary road construction constitutes an irretrievable commitment of soils and vegetation resources to a project. This is because they commit soils to nonproductive status for the duration of the road's existence and for several years afterwards, soil profiles are permanently altered from the *in situ* conditions, and vegetation (timber and forage) is removed from the traveled way. However, temporary roads are not an irreversible commitment of these resources, since soils eventually return to productive status after the road has been decommissioned and vegetation, including trees, typically returns to the road corridor.

Temporary roads are minimum design standard roads and therefore have fewer negative environmental effects that permanent roads. Typically, temporary roads are native surface roads that are simply "bladed" soil surfaces to smooth the soil surface sufficiently for log transport for short distances (i.e., usually less than a mile). Temporary roads usually do not have culverted stream crossings or long segments of fill material.

Both Action Alternatives will require installation of temporary roads. Alternative 2 would require approximately 330 miles of temporary roads in order to access areas for mechanical vegetation treatments, while Alternative 3 would require 170 miles of temporary roads.

Depending on temporary road locations and timing of use, these roads can adversely affect soil productivity for the duration of the road use and for several years following decommissioning and abandonment. Design criteria and BMPs in Appendix F of the Soils and Watershed Specialist's Report would limit adverse effects of temporary roads by preventing them from being located in sensitive areas (Aquatic Management Zones, near spring ecosystems, and in riparian habitats) except where designated stream crossings are necessary. Upon decommissioning, temporary roads would have water control features installed as needed, would be stabilized using logging slash to protect soil surfaces from raindrop impacts, minimize soil erosion, and prevent visitors from using the road for motorized travel.

Temporary roads are therefore expected to have minimal long-term effects to soil productivity, water quality, and vegetation and therefore watershed condition.

Existing system roads may be improved or realigned to provide serviceable and safe access for forest mechanical vegetation and prescribed fire treatments. These improvements will protect soil productivity and surface water quality by: a) preventing roadbed erosion through application of aggregate to provide a more stable and reliable running surface, b) provide road drainage that prevents erosion and sediment delivery to streamcourses, c) reduce effects of stream crossings through improved road stream crossing designs.

Road Use

Approximately 5,682 miles of National Forest System roads would be needed to implement the Action Alternatives. Vehicle traffic associated with project implementation, particularly trucks, tend to pulverize road surface aggregates, resulting in more fine particles that are easily transported in runoff. Road proximity and connectivity to drainages can strongly influence sediment delivery to watercourses and alter flow regimes in streams.

It is likely that traffic associated with mechanical restoration treatments and commercial timber sales would have short term adverse effects to surface water quality through sediment delivery to streamcourses and other water bodies and increases in turbidity. Use of Resource Protection Measures and applicable road BMPs would minimize and mitigate most adverse effects from road use, but would not eliminate them entirely. As previously noted, forest roads are typically one of the major sources of surface water quality degradation from forest operations.

Once mechanical treatments are completed and transportation of forest products and machinery no longer occur on a given road, adverse effects to water quality typically diminish and return to background level proportional to historic road use levels.

Road Decommissioning

Approximately 490 miles of poorly located and infrequently maintained system roads would be decommissioned under the Action Alternatives (200 on the Coconino National Forest and A-S National Forest and 290 miles on the TNF). Additionally, approximately 800 miles of unauthorized roads would be decommissioned on the A-S and Coconino National Forests.

Road decommissioning actions will vary, depending on road locations, conditions, and effects on other resources (e.g., soils, water quality and watershed conditon), but could include activities such as ripping, seeding, mulching, filling inside ditches, outsloping road prisms, removal of culverts and fill material, re-contouring of stream crossings, removal of unstable sidecast material or cutslope stabilization, and blocking of entrances to prevent future access. These activities would return unproductive or marginally productive soils to a more stable, productive status over the long term by improving water infiltration and vegetative ground cover and reducing erosion hazards. Stream crossings would be returned to a more natural condition, thus reducing runoff and sediment delivery into ephemeral stream channels or intermittent or pernnial waterbodies. Adverse effects to surface water quality caused by stormwater runoff from road surfaces would also be minimized. Modeled erosion rates of roads are, to a large degree, at or above tolerance erosion rates.

Use of residual woody debris from mechanical timber harvest (i.e., slash) or fuels reduction treatments for closing roads is a common practice for road decommissioning. However, this practice rarely improves hydrologic function where roads have interupted or redirected surface flows via ditches and cross drain culverts, road surfaces are severly compacted, or have channelized flow in the existing roadbed. Additionally, slash can be burned in wildfires and prescribed fires, leaving roads essentially reopened to unauthorized use. Slash alone does not appreciably contribute to native plant propagation within retired roadbeds. While slash can be used as a tool to prevent road use, it should be one component in a suite of road decommissioning practices described above that result in a more naturalized condition upon completion of road decommissioning.

Road decommissioning improves watershed condition by reducing open road densities within affected watersheds. Reducing the number of roaded miles per unit area of watershed reduces hydrologic impacts that roads have on that watershed. Hydrologic impacts such as stream crossings and hydrologic diversions that result from road ditches, cross drainages, etc. are therefore reduced. Road decommissioning typically results in improved soil productivity and water quality(Sosa-Perez and MacDonald, 2017).

Rock Pits and Wood Processing Sites

Rock Pits
As previously noted, expansion of rock pits under the Action Alternatives constitutes an irreversible and irretrievable commitment of 69 acres of soils, and geologic resources since productive land is permanently altered from its natural condition and converted to an unproductive condition in perpetuity and through the extraction of rock for road surfacing. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. Rock pit expansion limits future options for use of the converted sites and rock extraction eliminates future options for use of the extracted material. Both Action Alternatives would mean that 69 acres of rock pit expansion would occur, thereby making an irreversible and irretrievable commitment of natural resources.

Wood Processing Sites
The Action Alternatives would include 12 wood processing sites totaling 128 acres. The criteria for selection of sites suitable for wood processing included the following: flat uplands having less than 5 percent slope, more than 200 feet distance from ephemeral and intermittent stream channels, and more than 300 feet from meadows and springs. These design criteria, in addition to applicable Resource Protection Measures, would reduce the potential for adverse effects to surface water quality, stream channels, riparian resources, and spring ecosystems. However, these sites constitute an irretrievable commitment of soils and vegetation resources since soils would be committed to nonproductive status for the duration of each wood processing site's existence and vegetation removal would be required for establishing sites, reducing the areal extent of available forage or forest cover. The scale of this irretrievable commitment of soils and vegetation resources for the establishment of wood processing sites in the context of the total project area is minimal at 129 acres and would not likely have detectable adverse effects at the watershed scale.

Riparian, Spring and Stream Restoration

Comprehensive restoration activities included in the Action Alternatives and described in the Aquatic and Watershed Flexible Toolbox would directly improve stream channel morphology, riparian and slope wetland conditions, floodplain functionality and spring ecosystems. Restoring stream channel gradients and increasing channel sinuosity, restoring width-to-depth ratios and reconnecting stream channels to their historic floodplains would improve hydrogeological conditions at the watershed level. Surface flows, floodplain water storage, and sediment transport would all be improved. Activities such as installation of grade control structures has been shown to be effective for dissipating runoff energy, improving sediment storage, aggrading incised stream channels and reconnecting them to historic floodplains. Wet meadows would be effectively restored through implementation of these, and similar practices that eliminate single-thread streams and gullies that are drying out these wetlands. Planting native herbaceous riparian species, stabilizing stream banks, reducing bank steepness of entrenched channels and reconstructing riffle and pool formations would contribute to improved hydrologic function of stream channels

Since upland restoration actions (i.e., forest thinning and prescribed fire) could have a cumulative effect on restoration of riparian areas, springs and streams, it is imperative that upland restoration actions are staged in a manner that compliments comprehensive restoration activities. Upland restoration treatments are expected to produce varying levels of runoff and sediment delivery to riparian areas such as wet meadows and riparian stream corridors as well as stream channels themselves. Currently these areas are sediment deprived, meaning historic sediment loads originating from wildfires are absent. This, combined with historic overgrazing has resulted in gully and channel formation in meadows and incision of streamcourses. Conducting comprehensive restoration treatments prior to upland restoration actions would allow for sediment to deposit as alluvium where desired, rather than being transported through the system in a manner that increases surface scour. If staged optimally, upland restoration treatments combined with comprehensive restoration treatments would provide the greatest benefit to watershed condition through improved sediment capture and utilization, improved surface water quality through reduced suspended sediment loads, and nutrient storage and filtering in riparian areas.

There would likely be short-term, adverse effects to surface water quality through implementation of these restoration actions since they are often in-channel restoration practices, occur in wetland areas, or are in riparian areas immediately adjacent to stream channels and wetlands. With implementation of Resource Protection Measures and BMPs, adverse effects can be minimized or mitigated. Native riparian and wetland vegetation is expected reestablish in these areas soon after restoration activities are completed (1 to 3 years). In some areas, reestablishment of wetland or riparian vegetation would be hastened by planting of appropriate wetland or riparian herbaceous and woody species. Installation of protective exclosures around restored sites would reduce browsing and trampling by both domestic and wildlife ungulates.

Effects Unique to Each Action Alternative and Differences among Them

Mechanical Forest Restoration Treatments (Thinning)

One of the primary differences between Alternative 2 – Modified Proposed Action and Alternative 3- Focused Restoration is the number of acres and intensity of mechanical forest restoration treatments. Alternative 2 proposes to mechanically thin trees and/or implement prescribed fire on up to 953,130 acres, while Alternative 3 would mechanically treat slightly more than half (55 percent) of those acres at 529,060 acres. Alternative 2 addresses landscape-scale mechanical forest restoration across the majority of the Rim Country analysis area more effectively than Alternative 3. Alternative 3 is designed to focus restoration treatments in areas that exhibit the greatest departure from the natural range of variation (NRV) of ecological conditions, and/or that put communities at risk from undesirable fire behavior and effects. Therefore, Alternative 3 would leave the greatest number of acres that are moderately departed from desired ecological conditions and would benefit from mechanical restoration treatments to restore forest vegetation health and resilience.

Alternative 2 - The Modified Proposed Action

Since Alternative 2 would provide the greatest areal extent of forest mechanical restoration treatments, it would correspondingly result in a higher proportion of acres that are resilient and fire adapted. As a result, Alternative 2 would improve soil and watershed condition to a much larger degree that Alternative 3.

The greater number of acres that would be treated mechanically also means there would be a corresponding increase in short term adverse effects to soils, water quality and watershed condition. With the higher number of acres to be treated mechanically, adverse effects such as soil compaction, puddling, displacement, erosion, loss of soil organic matter, short-term changes in soil moisture content or retention, changes in nutrient cycles, changes in soil fauna, and risk of introduction of invasive and noxious weeds are likely. The extent and locations of such effects cannot be predicted with accuracy, although some generalizations can be made. Mechanical forest vegetation treatments under Alternative 2 would require more disturbance through construction of temporary roads and road use (330 miles of temporary roads under Alternative 2 vs. 170 miles of temporary roads under Alternative 3), and more log landings and skid trails. More frequent road maintenance would be required since there would be substantially more truck traffic under Alternative 2 than Alternative 3.

As previously noted, 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, and debris piling areas.

At the watershed scale, it is possible that the greater areal extent of mechanical vegetation treatments under Alternative 2 would result in increased water yield from watersheds where large percentages of the watershed are mechanically treated in a short timeframe. However, any increases in water yield would be short lived (i.e., 5 to 10 years) since understory vegetation would increase and the water uptake by grasses, forbs and shrubs and warmer soil temperatures would soon offset evapotranspiration lost from forest thinning.

Forest thinning 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 (i.e., sunflecks) resulting in an increase in grasses, forbs and shrubs in the forest understory where litter is currently the dominant soil cover.

Alternative 3 – Focused Restoration

Alternative 3 would result in substantially fewer acres being treated mechanically. There would therefore be correspondingly fewer acres that would exhibit adverse effects from mechanical forest restoration treatments such as soil compaction, puddling, displacement, erosion, loss of soil organic matter, short-term changes in soil moisture content or retention, changes in nutrient cycles, changes in soil fauna, and risk of introduction of invasive and noxious weeds. Adverse effects to surface water quality would also be reduced under Alternative 3. However, over the long term, there would be a much greater number of acres that would remain departed from vegetation and fuels desired conditions. These areas would likely remain at risk of high severity wildfire due to high fuel load levels.

Prescribed Fire

Alternative 2 – Modified Proposed Action

Alternative 2 proposed substantially more acres of prescribed fire than Alternative 3. Prescribed fire has the potential to impact soil productivity and surface water quality by increasing soil erosion rates and delivery of sediment, dissolved solids, and nutrients to streams and other waterbodies. Since more acres would be treated with prescribed fire under Alternative 2, it is reasonable to expect that there would be greater areal extent of short term adverse effects to soil productivity and water quality and therefore watershed condition. However, adverse effects of prescribed fire on soils, water quality and watershed condition would not be nearly as great as an uncontrolled wildfire.

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-intensity prescribed fires, an increase in grasses and other herbaceous vegetation often occurs. This rapid regrowth of ground cover further immobilizes nutrients in plant material.

The mobility and concentration of nutrients in soils determines whether or not nearby water sources are at risk of contamination when prescribed fire is used. 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).

Prescribed fires can adversely affect watershed hydrology. As vegetation is removed, evapotranspiration in the watershed decreases, thus increasing stream flow and overall water yield within the watershed. The increase in water yield may result in a corresponding increase in sediment and nutrient loads in surface waters.

Trends indicate that fuel loading would continue to increase in areas that are not thinned mechanically. Increased fuel loads would be in the form of both living forest vegetation and woody detritus. Ingrown forest conditions would facilitate the existence of 'ladder fuels' which allow ground fires to ascend into the canopy and spread quickly as crown fires.

High severity wildfires tend to occur in areas where fuel loading and fuel distributions are sufficient to carry a fire. Typically, uncontrolled wildfires occur during the drier times of the year, yielding higher severity fires than would occur under prescribed fire conditions. The adverse effects of a high severity fire, such as the loss of forest floor organic matter, increased soil erosion, and changes in soil biota would be more widespread in an uncontrolled wildfire than under prescribed fire conditions where the size and intensity of the fire can be controlled. The primary impact of high severity wildfire on soil productivity is the removal of surface organic matter, exposing soils to erosion by wind and rain. If surface organic matter is reduced (as happens with a high severity wildfire) the cation exchange capacity, a measure of soil fertility, is also reduced and the ability of the soil to retain nutrients leached from ash decreases.

Cumulative Effects

Cumulative effects include the impacts on the environment which result from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other action (40 CFR § 1508.7). The geographic setting for the cumulative effects analysis for soils and watersheds includes all of the 6th level (HUC-12) hydrologic unit subwatersheds that include Rim Country project area, which comprises approximately 137,153 acres. The timeframe for past actions is twenty five years, based on soil productivity, vegetative response, and coarse woody debris recovery within treated areas. This timeframe accounts for the 20 years of project implementation, plus 5 years of recovery after the last project activity is implemented. Surface disturbing activities that are older than 20 years are assumed to be contributing negligible or no measurable cumulative effect within the analysis area.

Alternative 1 – No Action

The No Action Alternative would result in no additional mechanical forest vegetation or prescribed fire treatments, no additional road construction, realignment or decommissioning, no additional spring or riparian restoration, no stream channel restoration, no rock pit expansion, and no wood processing site beyond what has been planned under separate NEPA analyses. Therefore, there would be no cumulative effects to soils or watershed condition as a result of the No Action Alternative beyond those already planned or being implemented under separate NEPA decisions. As can be seen in Appendix G of the Soils and Watershed Specialist's Report, the majority of past, present and reasonably foreseeable future actions consist of forest restoration and fuels reduction treatments. Other restoration actions such as grassland and meadow restoration, spring restoration, and fire rehabilitation are occurring, have occurred in the past or may occur in the future. Restoration projects are designed to improve forest and grassland vegetation conditions and therefore contribute to improved soil and watershed condition.

A cumulative effect of the No Action alternative includes ongoing erosion and sediment delivery to ephemeral channels from roads proposed for obliteration under the Action Alternatives that would not be obliterated under this Alternative. When combined with other activities in the proposed project area, sediment production from these roads could contribute to adverse effects to downstream surface water quality if these roads remain in an unstable, eroding condition.

When combined with past, present and reasonably foreseeable future actions, the No Action alternative would not contribute to appreciable improvement in soils or watershed conditions in watersheds that encompass the Rim Country analysis area.

Alternative 2 – Modified Proposed Action

Mechanical Forest Restoration Treatments, including Timber Harvesting

Soil Stability and Erosion Processes

Proposed meadow and riparian restoration and stream channel restoration will improve soil stability, nutrient cycling, vegetative cover, and hydrologic processes and therefore watershed condition. Cumulative effects of Alternative 2, in combination with past, present and reasonably foreseeable future action includes meadows (slope wetlands) that are storing water and recharging groundwater systems, stable against extreme runoff velocities and therefore less prone to headcutting and gully formation. Sediment delivery to streamcourses would be greatly reduced and would return to historic, or background levels due to reduced fire burn severity, improved vegetative cover of native perennial grasses and forbs.

Poorly located roads proposed for decommissioning are, in some cases acting in a similar manner as gullies, channelizing runoff into ephemeral and intermittent drainages and other waterbodies. Decommissioning of 490 miles of system roads and 800 miles of unauthorized routes will contribute to improved watershed condition at the landscape scale through reduction of roaded miles per unit of land area, leading to greater areal extent of naturalized watershed condition. When combined with other past, present and reasonably foreseeable future actions, road decommissioning under Alternative 2 would improve watershed condition throughout most of the project area more effectively than is currently occurring under the No Action Alternative or would occur under Alternative 3.

Nutrient Cycling

Soil nutrient cycling would progress toward desired conditions as tree litter layers (thick layers of pine needles) are replaced with vegetative cover and fine litter. Fine roots of grasses, forbs, and shrubs would improve soil aggregate stability, water infiltration, and decrease soil bulk densities. These conditions allow nutrients to translocate both vertically and laterally as water infiltrates and moves through soil matrices rather than being transported to water bodies in runoff.

Continued reintroduction of fire to these fire-adapted systems will result in progressively lower soil burn severities over time, resulting in only partial consumption and light charring of organic matter, resulting in more recalcitrant forms of organic matter that contribute to improve C:N ratios and incorporation of other nutrients (phosphorus, sulfur, potassium, etc.) into upper soil horizons.

Soil Hydrology

Historic evidence indicates that existing landings, skid trails, and roads constitute approximately 5 to 10 percent of the total project area. As previously noted, roads proposed for obliteration tend to be compacted and rutted, and are often channelizing surface runoff to surface waters and are not exhibiting substantial recovery. In order to mitigate any additional compaction and displacement of soils, temporary roads, skid trails, and landings would be stabilized using Resource Protection Measures and BMPs, which may include ripping or decompacting and seeding to alleviate reductions in porosity and infiltration capacity. Therefore, it is not expected that the percentage of compacted areas would increase substantially (i.e., beyond an additional 1 to 2 percent over the current condition). Any soil compaction resulting from mechanical vegetation treatments would be ameliorated over time through pedoturbation caused by soil freezing and thawing and wetting and drying cycles, and root elongation.

Areas of water repellency, which form as a result of the prescribed fire use are expected to recover within 1 to 3 years as natural pedoturbation processes described above occur.

Watershed Response

When combined with other past, present and reasonably foreseeable future projects, Alternative 2 would be beneficial to watershed response. In the absence of maintenance treatments this benefit would decrease over time as a result of forest ingrowth that would increase evapotranspirational demand.

Recreational Activities

Recreational activities within the proposed project area include: hiking, viewing wildlife, hunting, dispersed car-camping, backpack camping, orienteering, horseback riding, photography, picnicking, taking scenic drives, ORV/ATV use, bicycling, shooting, and gathering in family or social groups. Other common uses within the project area include firewood cutting, Christmas tree cutting, collecting boughs and cones, gathering antlers, and collecting food and medicinal resources such as berries, nuts, mushrooms, and medicinal plants. Of these, ORV/ATV use, dispersed camping, firewood collection and Christmas tree cutting have the greatest potential to result in adverse cumulative effects to soils through compaction, puddling, erosion, and displacement. These conditions would be limited to areas where such activities take place.

Restoration treatments will increase forest openings and provide more opportunity for recreational activities to be dispersed across the landscape rather than concentrated in a smaller number of areas. Dispersed recreation tends to have reduced impacts to soils, water quality and watershed condition in comparison to concentrated recreational use. In combination with past, present and reasonably foreseeable recreation activities, Alternative 2 would improve soils and watershed condition throughout the Rim Country analysis area through improved vegetative ground cover which provides for sustainable nutrient cycles and soil productivity, reduced erosion and sediment delivery to stream channels, and improved water quality and overall improved watershed condition.

Since Alternative 3 will result in fewer forest openings than Alternative 2, it is less likely to alter recreational patterns appreciably. Recreationists will continue to congregate in existing openings, resulting in excessive soil disturbance and loss of vegetative cover that reduce soil stability and hydrologic function. Soil erosion from such sites would likely continue to exceed tolerance thresholds.

Livestock Grazing

Currently, livestock grazing is authorized across most of the analysis area. While grazing results in discontinuous fuel patterns in grass, forb and shrub vegetative communities, it has not effectively reduced the densities in the ponderosa pine stands. As a result, excessive stand densities in the ponderosa pine vegetation type are causing a shift in understory vegetative communities toward more shade tolerant species such as bromes and mountain muhly.

Cumulative effects from livestock grazing when added to effects from restoration treatments would include minor, generally localized soil compaction, puddling, displacement and erosion from livestock trailing and in areas where animals congregate such as livestock waters and areas where mineral supplements are placed. Livestock trails make up a very small portion of the total project area and therefore have a negligible effect on soils or watershed condition. When added to the effects of the restoration treatments livestock grazing is not expected to increase the area of soils characterized as unsatisfactory within the cumulative effects area. Overall, in combination with ongoing livestock grazing and in the absence of increasing livestock numbers being grazed, Alternative 2 would benefit soils and watershed conditions to a greater extent than alternative 3.

Invasive and Noxious Weeds

The cumulative effect of the increased risk of spread on noxious weeds on soil productivity can only be described in general terms because of the large number of unknown variables. Areas where soil disturbance includes compaction, displacement, erosion, and excessive heating are at the greatest risk of invasion by noxious weeds. These include temporary roads, areas where concentrated harvesting operations occur and pile burning sites. To minimize cumulative adverse effects of invasive and noxious weeds, observed infestations would be managed in accordance with the Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds Coconino, Kaibab, and Prescott National Forests (2005).

Fire Effects

In low burn severity areas, effects are mainly light ground char where the litter is scorched, charred, or partially consumed. The litter layer, or duff is largely intact, although it may be charred on the surface. Woody debris accumulations are partially scorched, charred, or consumed. Mineral soil properties are not adversely affected. In fact, low severity fire releases nutrients stored in surface organic matter and live vegetation. These nutrients facilitate rapid reestablishment of vegetative ground cover since root to shoot ratios are improved for grasses and forbs that survive fire, resulting in protection of soils from accelerated soil erosion soon after fire has occurred. Evidence of sheet and rill erosion as a result of low severity fire is typically very minor or nonexistent. In forested areas, much of the tree overstory is green with some scorch at the base of the trees and in the lower branches following low severity fire. Most trees survive; however, pockets of seedlings, saplings, and mature trees can be killed or consumed where moderate to high severity fires occur. While most of the shrubs, forbs and grasses are affected under low severity fire conditions, in most cases, much of this vegetation survives. Areas identified as low burn severity may also contain large unburned areas, resulting in a mosaic of burned and unburned conditions across the landscape or within a subwatershed. When combined with other past, present and reasonably foreseeable prescribed fire project, Alternative 2 would have beneficial effects on soils and watershed conditions.

Cumulative watershed effects

In summary, cumulative watershed effects from implementation of the Alternative 2 would include improved soils and watershed condition and restoration of the ecological interrelationships of soils, vegetation, and watersheds throughout the Rim Country project area. Streams, meadows and riparian areas that depend on stable upland soils would be better protected from potential adverse effects of high severity wildfire as a result of restoration treatments. The transportation system would provide necessary access for future management and would be more sustainable than the current transportation system. Short-term negative effects to soils, water quality, and watershed conditions, primarily through soil disturbance and loss of vegetative cover would be greater under Alternative 2 than Alternative 3. However, these effects will generally not persist beyond 3-5 years following each discrete disturbance. Since Alternative 3 results in greater areal extent of areas that remain untreated, these areas will remain at risk of high severity wildfire, concentrated recreational uses, and erosion and sediment delivery from roads that are not decommissioned. Alternative 2 therefore has greater long term benefit to soils and watershed condition than Alternative 3.

Alternative 3 – Focused Restoration

Cumulative effects of Alternative 3 would be similar to those of Alternative 2, but would occur at a substantially reduced areal extent with regard to forest mechanical thinning and prescribed fire treatments. Add a one or two sentences that clarify the substantially reduced areal extent blurb.

Other restoration actions (stream channel restoration, spring restoration, road decommissioning, etc. would be the same as Alternative 2.

Vegetation

The vegetation analysis is summarized from the Silviculture Report, which is incorporated by reference (Moore 2019).

Affected Environment

The cover types analyzed are limited to Aspen, Grassland/Meadow, Madrean Encinal Woodland, Madrean Pinyon-Oak, Mixed Conifer with Aspen, Mixed Conifer/ Frequent Fire, Pinyon-Juniper Woodland, Ponderosa Pine, and Ponderosa Pine/ Evergreen Oak and riparian for a total of 951,691 acres. For analysis purposes, the Madrean Encinal Woodland and Madrean Pinyon-Oak cover types will be combined into one category called Madrean Woodland due to limited acreage, data availability and similarity.

Of the 1,238,658 acres within the project area:

- Approximately 255,249 acres have been removed from this silvicultural analysis because they are part of an ongoing project or are being analyzed in a separate analysis (Figure 3). Silvicultural treatments and their effects within these areas will not be analyzed in this report.
- Approximately 30,263 acres are either non National Forest System lands, or are non-forested.
- An additional 1,141 of these acres identified as "Other" in Table 4 were determined to be either surface water, mineral pits, dams or road surface and will not be given a detailed description in this silvicultural analysis.
- The remaining 951,691 acres, considered the analysis area, will be analyzed in this report.

The descriptions of the existing condition are organized under the criteria determined to be part of a properly functioning ecosystem. An ecosystem that is properly functioning is thought to be resilient to perturbations in structure, composition, and biological or physical processes. Systems at risk are those that may be degraded beyond the range of resiliency and sustainability. The four ecosystem characteristics discussed below are cover type, composition, structure, pattern, and processes.

Post-European Settlement Era Ecological Changes

Open, frequent fire forest structure has been altered by logging, grazing, and fire suppression and has led to overly dense forest structure and fire regimes highly departed from their desired conditions.

Large, old ponderosa pines and oaks have become underrepresented in some areas. The remaining large, old ponderosa pines are suffering increased mortality rates as a result of competition with small trees, insects and disease, and climate change.

Ponderosa pine forests have increased in density as abundant tree seedlings have regenerated in canopy openings and replaced some open, multiple age class forest structure with a dense and predominately single age class structure. This resulted from logging practices, protection from fire, grazing, and a relatively wet climatic cycle during the early part of the 20th century (Schubert 1974). In other areas, uneven-aged stand structure remains as a result of historical mechanical harvesting as well as natural disturbance.

Frequent low-severity fire regime forests have increased densities from shade tolerant and fire intolerant species. Dry mixed conifer forests are far denser and with a species composition that is not necessarily representative of their NRV. Competition for moisture and nutrients is intense in currently dense stands, and results in stress that increases vulnerability to attack by insects such as pine bark beetles (*Dendroctonus* spp.) and ips beetles (*Ips* spp.) (Kane and Kolb, 2014).

While experts think that the extent of dwarf mistletoe has increased only modestly, the abundance and intensity of infections have increased substantially across the project area (Conklin and Fairweather 2010) due to closed forest conditions, lack of low severity fire, and lack of adequate mitigation management. This increased infection severity has been associated with decreased resilience to beetle- and drought-induced mortality (Kenaley 2008), reduced forest health and growth, accumulated ladder fuels (Conklin 2000), and negative effects from projected climate change.

Potential fire severity has changed from mostly low severity fire to mixed and high severity. The risk of stand replacing fires has increased. High severity fires often result in ecosystem conversions, increased soil erosion, loss of hydrologic function, and invasion by nonnative species. Stand-replacing wildfires within ponderosa pine ecosystems have resulted in conversion from forest to grass or persistent shrub for long periods or dense, even-aged structure. These areas would not again support old-growth forest structure for centuries. Trees have significantly encroached into historical grasslands and meadows.

Vegetation Composition

Vegetative composition refers to the vegetation cover types, species present and their relative abundance.

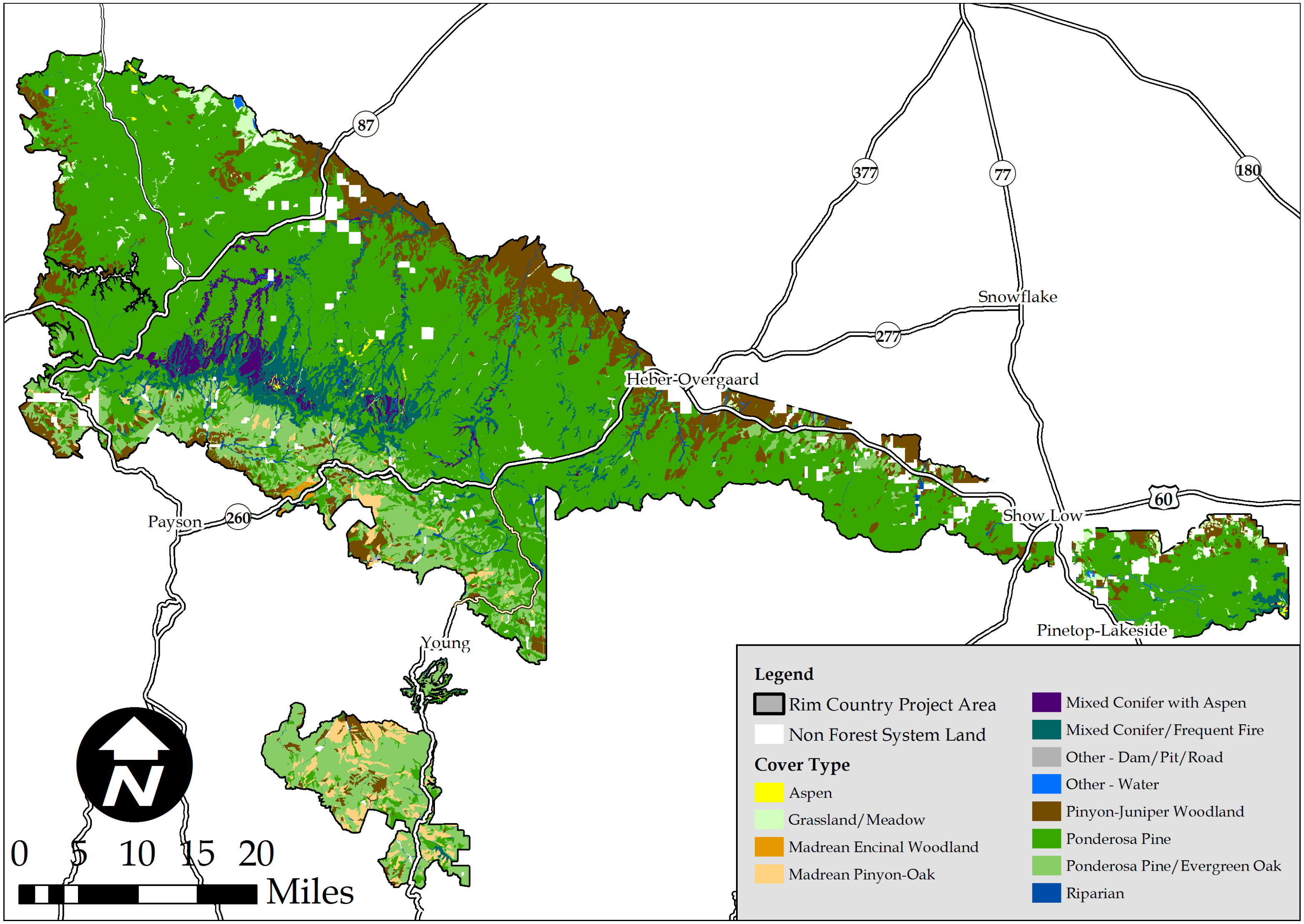
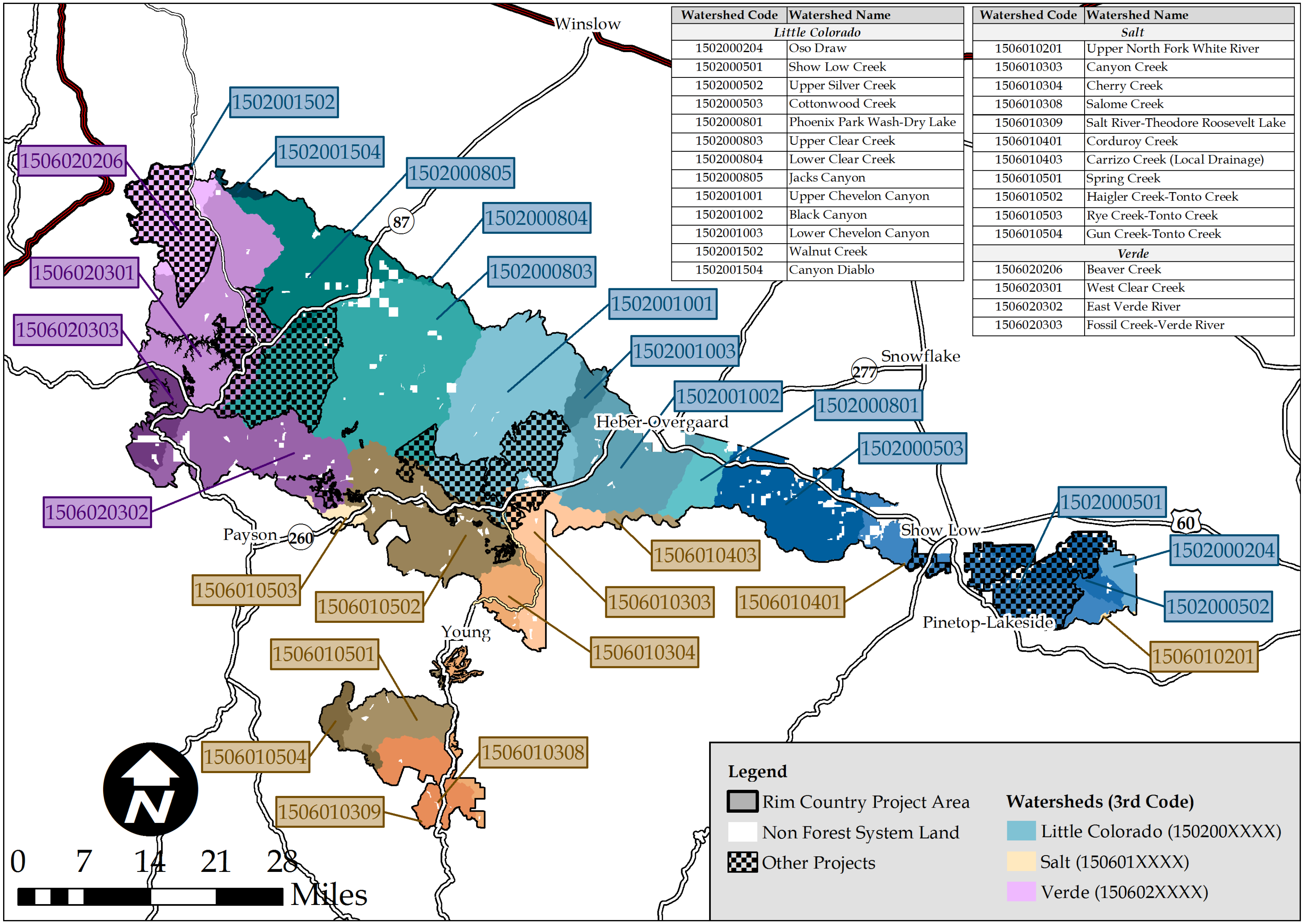


Figure 15. Existing condition – cover type



Watershed Code	Watershed Name
Little Colorado	
1502000204	Oso Draw
1502000501	Show Low Creek
1502000502	Upper Silver Creek
1502000503	Cottonwood Creek
1502000801	Phoenix Park Wash-Dry Lake
1502000803	Upper Clear Creek
1502000804	Lower Clear Creek
1502000805	Jacks Canyon
1502001001	Upper Chevelon Canyon
1502001002	Black Canyon
1502001003	Lower Chevelon Canyon
1502001502	Walnut Creek
1502001504	Canyon Diablo

Watershed Code	Watershed Name
Salt	
1506010201	Upper North Fork White River
1506010303	Canyon Creek
1506010304	Cherry Creek
1506010308	Salome Creek
1506010309	Salt River-Theodore Roosevelt Lake
1506010401	Corduroy Creek
1506010403	Carrizo Creek (Local Drainage)
1506010501	Spring Creek
1506010502	Haigler Creek-Tonto Creek
1506010503	Rye Creek-Tonto Creek
1506010504	Gun Creek-Tonto Creek
Verde	
1506020206	Beaver Creek
1506020301	West Clear Creek
1506020302	East Verde River
1506020303	Fossil Creek-Verde River

Figure 16. Existing condition – 5th HUC watersheds

Vegetation Structure

Uneven-aged Structure

Structure is a means to express the balance of age and size classes as well as the horizontal and vertical distribution of layers in the forest canopy. In a forested environment, vegetation structure can also include snags, down logs and woody debris, and canopy closure.

Uneven-aged forests are generally described as having three or more distinct age classes of trees (SAF 1998) and is a measure of vertical structure within a forest. Ponderosa pine is composed of trees in structural stages that range from young to old trees and are dominated by ponderosa pine. Currently, the arrangement of the tree cohorts (groups of trees of a similar age class) or size classes are in conditions conducive to crown fire with extremely dense and continuous overstory canopies in a closed condition and understory canopies acting as ladder fuels supporting a transition from surface fire to crown fire behavior. A size–class distribution by 5th HUC watershed shows that the majority of basal area (63 percent overall) is concentrated in the 5 to 12 inch and 12 to 18 inch size classes.

Density

Overall, basal areas are high for most cover types, especially Aspen, Dry Mixed Conifer, Ponderosa Pine/Evergreen Oak, and Mixed Conifer with Aspen. Average basal area of ponderosa pine cover type across the analysis areas is lower, largely due to the number of ponderosa pine stands that experienced stand replacing fire in the Rodeo-Chediski Fire in 2002 and are now dominated by stands with low basal area.

Large Tree and Old Tree Structure

Ponderosa pine stands of post settlement trees where the quadratic mean diameter of the top 20 percent of trees is greater than 15 inches and the basal area of trees greater that 16 inches is more than 50 square feet of basal area may be considered stands with a preponderance of large young trees (SPLYT stands). These stands occur outside of MSO PACs, MSO Recovery habitat and WUI and are being identified for their distinctive forest structure. Information on SPLYT stands across 5th HUC watershed is shown in Table 3-6.

Forest Process

Insects

A general bark beetle hazard model for southwestern ponderosa pine based exclusively on the tree density relationships developed in a Dendroctonus hazard model was validated by Chojnacky et al. (2000) The model indicates that stands of ponderosa pine within the analysis area with a relative density below 30 percent of SDImax have a low hazard rating and stands between 30 and 40 percent of SDImax have a moderate hazard rating. Using these relative density thresholds, approximately 19 percent of the analysis area has a low bark beetle hazard rating, while 7 percent of the area has a moderate rating and the remaining 74 percent has a high hazard of beetle attack.

Pathogens-Dwarf Mistletoe

Conklin and Fairweather (2010) indicate that stands with less than 20 percent of the ponderosa pine trees infected can be considered a light infection, stands with 20-80 percent can be considered moderately infected while stands with greater than 80 percent of trees infected with dwarf mistletoe are classified as severe. At moderate and severe infection levels there is evidence of decreased tree vigor, increased susceptibility to insect infestations, and stress-related (e.g., drought) mortality that accompany a changing climate.

Assumptions and Methodology

The basic unit for characterizing of vegetation conditions is the stand. All lands within the Apache-Sitgreaves, Coconino and Tonto National Forests are delineated into stands based on similar characteristics such as vegetation cover type, slope, aspect, species composition, aerial photo interpretation signatures, and management history. Stands vary in size depending upon their uniformity; within the Rim Country Project this is from less than one acre up to 1,324 acres. Spatial and general vegetation information about each stand is stored in the stand database for each forest within the Forest Service Field Sampled Vegetation (FSVeg) database.

Data Rounding

Data is typically reported to the nearest acre, mile, or percentage. Most values have been rounded from their actual decimal values. Totals were calculated before any values were rounded in order to give the most accurate sum. Any apparent inconsistency between the total values reported in a table and a sum resulting from adding up individual values in a table typically accounts for a discrepancy of about 1 percent in the case of rounding percentages or miles, and less than 2 acres in the case of acres.

In an attempt to avoid confusion over these kinds of inconsistencies, minor adjustments to the numbers in the EIS document were made to allow for numbers in tables to add up correctly as displayed. As a result, some numbers may not be exactly the same in the EIS document as compared to this report. The numbers in this report are the most accurate and any differences do not alter any determination of effects.

Stand Data and Modeling

Stand exam data is an average characterization of the area within the stand boundaries. It is limited by sampling intensity and the variability within the sampled area. Comprehensive tree data has been collected on a subset of the stands within the analysis area over the last 25 years. Within each sampled stand, tree characteristics were measured at sample points, using both variable basal area factor plot and fixed plot designs. Specific tree data collected includes species, class, diameter, height, age, growth, damage and disease. Other data sometimes collected depending on design included surface fuels and plant association (USDA 2013).

Modeling Assumptions

The following is a list of general modeling assumptions.

- All tree data was grown to the common year of 2019 and is considered to represent the existing condition.
- Beginning in the year 2019, using the Climate-FVS extension (N.L. Crookston 2014), the effects of climate change were incorporated in the data analysis using the Ensemble_rcp60 scenario
- All tree cutting and removal was modeled in the year 2019 as 2019 is the earliest anticipated first year of treatments
- Two prescribed burns were modeled, post-mechanical treatment in the year 2024, and then again in 2034 with the exception of the aspen treatment which modeled one prescribed burn in the year 2024, post-mechanical treatment.

- After treatment, the tree growth data was simulated to the common year of 2029 and 2039 and is considered to represent the post treatment condition.
- The tree data does not indicate tree age. Simulations initially use diameter as a surrogate for age based on the vegetative structural stage definitions. We acknowledge that there are trees on the landscape where age class overlaps size class. For example there may be: young trees that are larger than 11.9 inches; or mid-aged trees that are larger than 17.9 inches; or mature trees that are less than 18”.
- Within this project area, the majority of trees that meet the old tree definition are greater than or equal to 18”. On the ground cutting prescriptions would follow the Old Tree Implementation Plan (OTIP) and trees larger than 18” that do not meet the OTIP criteria may be cut during implementation.
- All cutting simulations assume 15 percent of the cut stems are left on site and 10 percent of the branchwood from the cut and removed stems are left on site. All other biomass resulting from the cutting is assumed to be removed.
- Snags and coarse wood amounts are based on the inventory or default parameters within the model if they were not inventoried. Snag fall rates and changes in surface fuels are based on default parameters.
- Stand exam data is an average characterization of the area within the stand boundaries. It is limited by sampling intensity and the variability within the sampled area.
- Default parameters within the model were used to predict tree growth, mortality, and dwarf mistletoe infection intensification.
    - ♦ Dwarf mistletoe infections are nearly impossible to detect from remote imagery. Therefore, any nearest neighbor imputation process may impute stand data showing mistletoe infections to stands that are not infected and visa-versa.
- FVS is a distance-independent growth model. It is not spatially explicit and cannot model tree groups and interspaces together. The modeling results are an average approximation of the desired forested structure at the stand level and all results are interpreted as “attribute values” per acre. Output from the FVS model used in this analysis is a characterization of the existing condition and absolute conditions are neither intended nor implied.

Discussions on Stand Metrics

Measures of stand density used in this analysis are Basal Area (BA), Trees per Acre (TPA) and Stand Density Index (SDI). Basal area is the cross-sectional area of all trees, measured in square feet per acre measured at 4.5 feet above the ground. Trees per acre (TPA) is simply a count of the total number of trees on an acre. Stand Density Index is a measure of the relative stand density within forest stands.

Density

Stand density, a measure of the degree of crowding within stocked areas (SAF 1998), is the dominant factor affecting the health and vigor of conifer forests in the western United States (Foresters 2005) and high stand densities leads to reduced ecosystem resilience (Reynolds et al 2013. One of the major factors affecting forest structure and development, specifically the rate at which individual trees grow and advance through successional stages, is inter-tree competition. Competition refers to density-related scarcity of one or more environmental factors necessary for growth (e.g., moisture, nutrients, and sunlight).

Trees per Acre

Trees per acre is simply a count of the number of stems per acre of an individual species or all species combined regardless of size. Trees per acre is much more informative when considered with an additional stand metric such as quadratic mean diameter or basal area. This additional information provides insight into the forest processes that may be occurring within a stand.

Basal Area

Basal area is the cross-sectional of all stems of a species or all stems in a stand measured at breast height (4.5 feet above the ground) and expressed as square feet per acre. This analysis uses basal area as a key measure of density. Higher basal areas can be indicators of increased competition, risk to insect outbreaks, and density-dependent mortality as well as closed canopy conditions.

Stand Density Index

Stand Density Index (SDI) is a measure of relative stand density based on the number of trees per acre and the mean diameter (Reineke 1933). Percent SDIMax expresses the actual density in a stand relative to a theoretical maximum density possible for trees of that diameter and species. SDI is a good indicator of how site resources are being used by taking both tree size (DBH) and numbers (TPA) into account.

Those who use SDI, or any index of stand density, as an estimate of growing stock, must assume that the index is proportional to site utilization (Long and Smith 1984). Since the contribution of individual stand components to both total SDI and total site utilization is additive, SDI can be used to assess control of growing stock in uneven-aged stands as well as even-aged stands (Long and Smith 1984). Although SDI and the maximum size-density relationship were originally described for pure, even-aged stands, Long and Daniel (1990) have proposed extension of its utility to uneven-aged and multi-aged situations.

Long (1985) divided SDI percentages into four zones which consider the percent of a stand occupied by trees. Based upon established forest density/vigor relationships, density-related mortality from competition begins to occur once the forest reaches 45-50 percent of maximum stand density (zone 3), and mortality is likely at density levels of 60 percent+ of maximum stand density (zone 4).

Openness

A key characteristic of historical ponderosa pine and mixed conifer forests was the grass-forb-shrub interspersed among tree groups; defined as interspace. This interspace typically comprised a large portion of the landscape. The term openness as used in this analysis conveys the percentage of the forested area that is grass-forb-shrub interspace.

Issues/Indicators/Analysis Topics

Issues

Issues are statements of cause and effect, linking environmental effects to proposed activities. Comments from the public, the 4FRI Stakeholder Group, other agencies, tribes, and Forest Service personnel were used to formulate issues concerning the proposed action. All comments received were reviewed and analyzed by the interdisciplinary team to "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review…" (Council on Environmental Quality, Sec. 1506.3; 40 CFR 1501.7(a) (3)).

Issue 3 – Large Tree Retention

This issue is addressed in the effects analysis for all alternatives. Large trees are addressed with treatment design and location, design features, mitigation measures, and BMPs to manage for desirable distributions of old trees and groups of large trees in all action alternatives. The Old Growth Implementation Plan and Large Tree Implementation Plan (OTIP/LTIP) were developed for the Rim Country to be responsive to these issues while also being appropriate to the specific ecology and existing conditions in this project area.

Indicators/Measures:

- Number of acres of stands meeting criteria for SPLYT designation.

Significant Issues Responded to in Alternatives to the Proposed Action

Issue 4 – Dwarf Mistletoe Mitigation

This issue will be addressed in the effects analysis for all alternatives. Dwarf mistletoe mitigation will be addressed with treatment design and location and collaboratively developed guidance in the implementation plan (appendix D). Some dwarf mistletoe will be retained as a natural component for wildlife, and limits will be placed on removal of large infected trees. The alternatives will propose a range of mitigation treatments depending on the severity and extent of infection.

Indicators/Measures:

- Acres of intermediate thinning proposed in stands with severe dwarf mistletoe infection
- Percent of acres in dwarf mistletoe severity rating classes

Environmental Consequences

In order to conduct a site-specific analysis, data from individual stands was used to calculate stand metrics. In order to scale these metrics up to a landscape level analysis, stand data was aggregated up to the 5th HUC watershed and then to the analysis area. The effects analysis period modeled is from 2019 to 2039.

Table 23. Desired and existing conditions for the project area

	Desired Condition	Existing Condition
Structure - Pattern	The majority of stands are in an open condition. Forest arrangement is in individual trees, small clumps, and groups of trees or randomly spaced trees interspersed within variably sized openings of grasses, forbs, and shrubs that are similar to historic patterns. Most forest stands in uneven-aged condition to meet forest resilience and sustainability goals while maintaining wildlife habitat.	The majority of stands are in a closed condition and lacking groups and clumps of trees or randomly spaced trees. Grasses, forbs and shrubs are underrepresented compared to historic patterns. This is departed from desired conditions consisting of a matrix of groups, clumps and individual randomly spaced trees with interspaces,
Structure - Trees per acre	Trees are distributed across size classes with total number of trees per acre between 10 and 250. Below is an idealized tree distribution across size classes totaling 74 trees per acre and carrying 90 ft^2 of basal area Trees are distributed across size classes with total number of trees per acre between 10 and 250. An idealized tree distribution across size classes totaling 74 trees per acre and carrying 90 ft^2 of basal area would have 24, 18, 14, 10, and 8 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.	Total trees per acre is higher than the desired condition and are overrepresented in the smaller diameter classes and underrepresented in the larger classes Total trees per acre is higher than the desired condition and are overrepresented in the smaller diameter classes and underrepresented in the larger classes. There are currently 813, 114, 35, 9, and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.
Basal Area	Generally less than 90 square feet per acre to meet forest resilience goals while maintaining wildlife habitat desired conditions. For MSO protected and nest/roost replacement habitat 110 to 120 square feet per acre is the minimum.	The current average basal area within the analysis area is 129 square feet per acre. High densities in terms of basal area make trees more susceptible to mortality from insects, disease, and competition and increase crown fire risk.
Stand Density Index	Maintain forest density between 25% and 45% of SDImax to maintain forest health and tree growth. For ponderosa pine this SDI range is between 112.5 and 202.5. For MSO protected and Nest/Roost replacement habitat, desired forest density is between 45% and 60% of SDImax or between 202.5 and 270.	Currently the average stand density index across the analysis area is 66% of MaxSDI. 21 % of stands meet the desired condition for SDI. High densities in terms of stand density index make trees more susceptible to mortality from insects, disease, and competition and increase crown fire risk.
Forest Insects	Stands in the analysis area are in the Low or Moderate hazard for bark beetles	Currently 74% of acreage have a high bark beetle hazard rating. The remaining 26% of stands meet the desired condition for insect hazard.
Forest Disease	Stands in the analysis area have Low to Moderate dwarf mistletoe infection severity (Less than 20% of trees infected)	Currently 75% of acreage has a low dwarf mistletoe infection rating, 22% of acres have a moderate rating and 4% have a severe infection rating. 96% of the analysis area meets the desired condition for mistletoe infection severity

Alternative 1 – No Action

Direct and Indirect Effects

Under Alternative 1 no acres would receive either prescribed cutting or prescribed fire treatment. Although this alternative does appear to meet some of the desired conditions identified in the Forest Plan concerning forest structure, it would not move the forest forward in initiating the re-establishment of a fire-adapted, resilient, diverse, and sustainable forest ecosystem. For example, based on a broad array of research, current stand conditions would continue to develop so that the overabundance of trees in the smaller size classes (0-5 and 5-12 inch size classes) at the landscape scale, but they would likely develop at a slower rate due to increased competition and water stress. At the same time, the slow transition of intermediate and mature forests would lead to an increasing lack of young, developing forests. In the likely case of one or more large disturbance events (wildfire, drought, insects), the result would be an over-abundance of young forests. For a more thorough analysis of the effects of larges disturbance such as uncharacteristically large or severe wildfires, consult the Fire Ecology Specialist Report (USDA 2019).

Without treatment, stands in the analysis area would be much less resilient to disturbances such as multi-year drought, insects and disease such as bark beetle and mistletoe, and wildfire (Abella, et al., 2007). Increased drought stress and insect attacks are often associated with increased tree density, altered tree spatial arrangement, and shifted forest composition that have resulted from fire exclusion, grazing, and past logging. These changes in forest structure may exacerbate tree mortality due to increased competition among trees (Kane, Kolb, & McMillin, 2014, p. 171). At the fine scale, these disturbances would likely result in a greater mortality rate for areas with dense forest, which include groups and clumps of large trees (Zhang, Ritchie, Maguire, & Oliver, 2013).

Composition

Forest composition is not expected to change dramatically under this alternative if there are no large-scale disturbances such as wildfire or epidemic-level insect outbreaks. Ponderosa pine would still be the dominant cover type within the analysis area. Mixed conifer would make up a moderate proportion of the analysis area, though the composition of shade tolerant species such as white fir may increase considerably in this forest type. Juniper, grasslands, and other hardwoods would continue to make up a minor part of the analysis area. Without wildfire or other types of disturbance, aspen would continue to decline, as normal succession pressures continue to favor conifer establishment. This continued encroachment may result in the loss of aspen from parts or all of the analysis area.

In general, overstory density would increase and understory species richness would decline significantly (Korb & Springer, 2003). Without treatment, understory grass vigor would be expected to be reduced. Less sunlight would reach the forest floor. As a result, understory diversity would decrease, which would reduce the overall biodiversity found in frequent-fire forests.

Structure

Uneven-aged Structure

Uneven-aged forest structure is the Desired Condition. Under this alternative, there is little change to forest structure (Figure 17). Some trees would grow into larger size classes, but the overall the portion of stands that can be considered uneven-aged remains unchanged. The uncharacteristically high number of trees in the smaller and medium size classes provide excessive competition with larger trees in the stand, slowing growth and limiting diameter growth of the largest trees in the stand. While this meets the Desired Condition, it provides little improvement over the Existing Condition into the future.

While this indicator meets the desired conditions for uneven-aged structure in the forest plans, this does not account for the possibility of an uncharacteristic wildfire or other substantial disturbance event, such as a beetle outbreak or long-term drought. There are an abundance of small diameter trees across the analysis area, far above historic conditions. Because of the current structure, including overstocked forests and ladder fuels created when smaller trees grow directly beneath the canopy of larger trees, the current landscape would be less resilient if a catastrophic event were to occur. Many, if not most, of the trees would be killed, resulting in large areas lacking live trees. Natural regeneration or reforestation planting would create large even-aged, young forests, with little structural diversity for the foreseeable future.

Density

Measure of density in this analysis include trees per acre, basal area and stand density index. The overall tree density continues to remain very high under this alternative, averaging nearly 1,000 trees per acre through much of the area. All 5th HUC watersheds currently do not meet the desired condition for trees per acre. In general trees are overrepresented in the smaller size classes and underrepresented in the larger size classes. Smaller trees and their aggregated spatial pattern on the landscape has resulted in dense thickets of "dog-haired" pine. While there would be some density-related mortality in the smaller trees as time goes by, this trend of "dog-haired" thickets of pine is expected to continue into the foreseeable future under this alternative. Across the analysis area, forested stands would continue to be dominated by small diameter trees into the future. This tree density would result in reduced tree growth and increased mortality, especially in older trees, stagnated nutrient cycles, decreased herbaceous and shrub forage quality and quantity (Covington & Moore, 1994a). Without cutting or fire disturbances, tree regeneration would be inhibited and the trend would be a shift to the larger size classes maintaining extremely dense conditions that are not resilient to disturbances such as fire, insects, and climate.

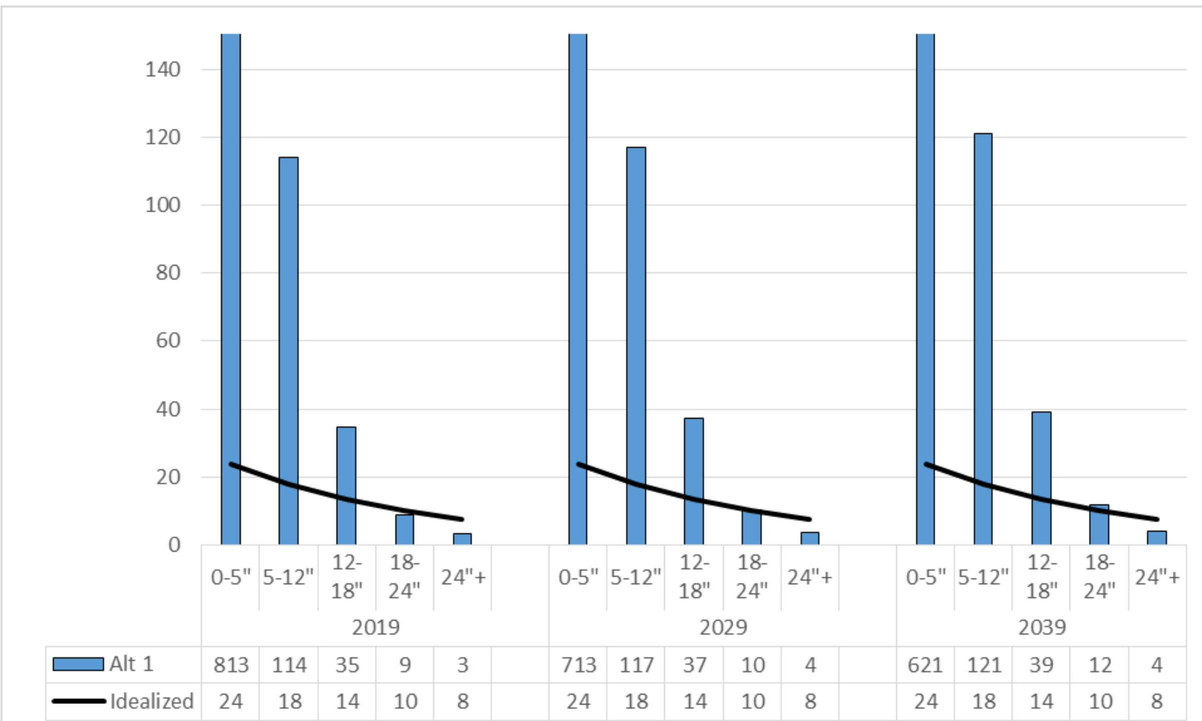


Figure 17. Alternative 1 – No Action – Distribution of trees per acre across size classes across the analysis area as well as an idealized distribution of trees per acre

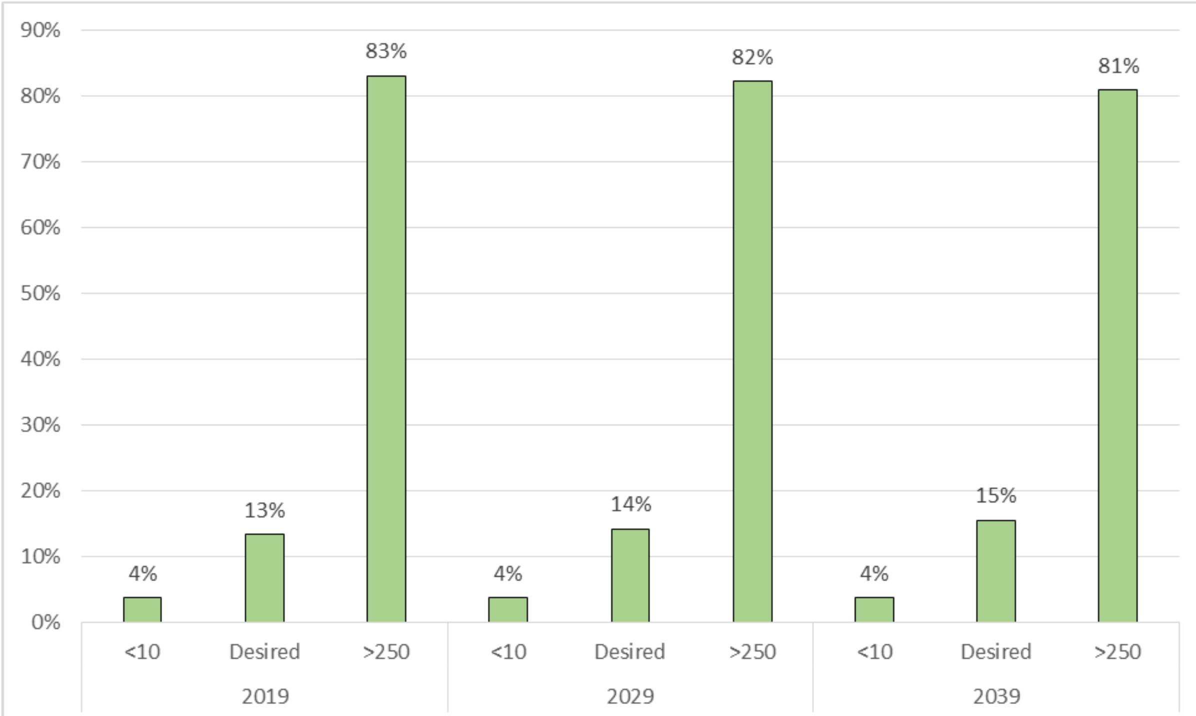


Figure 18. Alternative 1 – No Action – Percent of acres meeting desired condition for trees per acre across the analysis area

Under the No Action alternative, basal areas across the analysis area would average 129 square feet per acre, ranging from 60 square feet per acre in the Carrizo Creek watershed, which has experienced a considerable amount of uncharacteristic severity wildfire, to 166 square feet per acre in the Salome watershed, and Haigler Creek-Tonto Creek watershed, dominated by dense ponderosa pine evergreen oak cover type. This excessive stocking is expected to increase to, on average, 150 square feet per acre by 2039. Currently only 19 percent of acreage meets the desired condition for basal area. The percentage of stands that meet the desired condition would be reduced to 12 percent by 2039 under the No Action alternative.

Continuous tree growth would allow for forest stand densities to depart further from the desired condition. This would result in increasing competition for limited resources (water, light, growing space, and soil nutrients). Competition-induced mortality and growth stagnation would continue to increase, along with susceptibility to potential insect and disease outbreaks. The current conditions and effects of no action over the next thirty years support a shift away from frequent, low severity surface fires to increasingly larger high severity intensity crown fires (Cooper, 1960) (Swetnam, 1990) (Covington & Moore, 1994a) (Kolb, Wagner, & Covington, 1994) (Swetnam & Baisan, 1996). For more information consult the Fire Ecology Specialist Report (USDA 2019). These conditions would not meet the purpose and need for fire-adapted, resilient, diverse, and sustainable forest ecosystems.

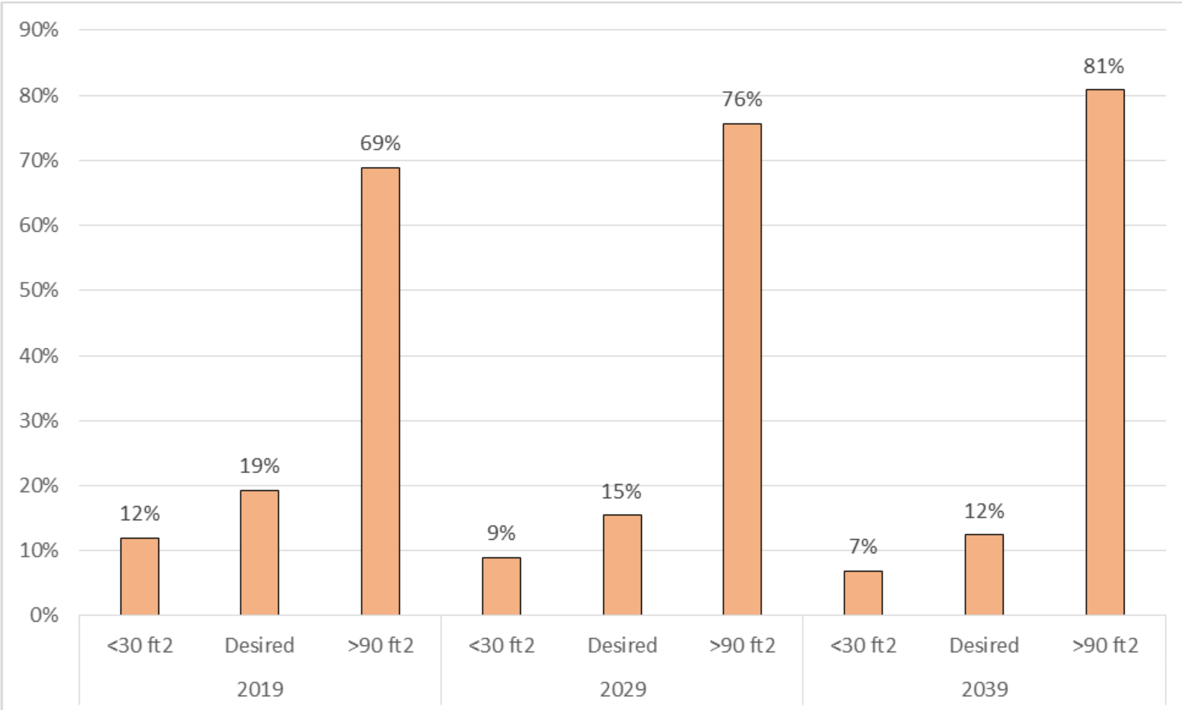


Figure 19. Alternative 1 - No Action – Percent of acres meeting desired condition for basal area across the analysis area

Stand Density Index (SDI) is a measure of relative stand density based on the number of trees per acre and the mean diameter (Long 1995). Percent SDImax expresses the actual density in a stand relative to a theoretical maximum density possible for trees of that diameter and species (SDIMax is 450 for this analysis). SDI is a good indicator of how site resources are being used by taking both average tree size and trees per acre into account. SDImax represents an empirically-based estimate of the maximum combination of quadratic mean diameter and density which can exist for any stand of a particular forest type.

Currently across the analysis area, SDI averages 296 or 66 percent of SDImax and is considered in the zone where density related mortality is prominent and approaching the zone where imminent mortality would occur. Values range from 140 in the Carrizo Creek watershed, which has experienced a considerable amount of uncharacteristically severe wildfire to 400 in the Haigler Creek-Tonto Creek watershed which has a substantial amount of the ponderosa pine evergreen oak cover type. Overall, SDI and its relation to SDImax continues to increase to 324 or 70 percent of SDImax by 2039. In relation the desired condition, currently 15 percent of acres within the analysis area meet desired condition for SDI. This number would decrease to 11 percent by 2039.

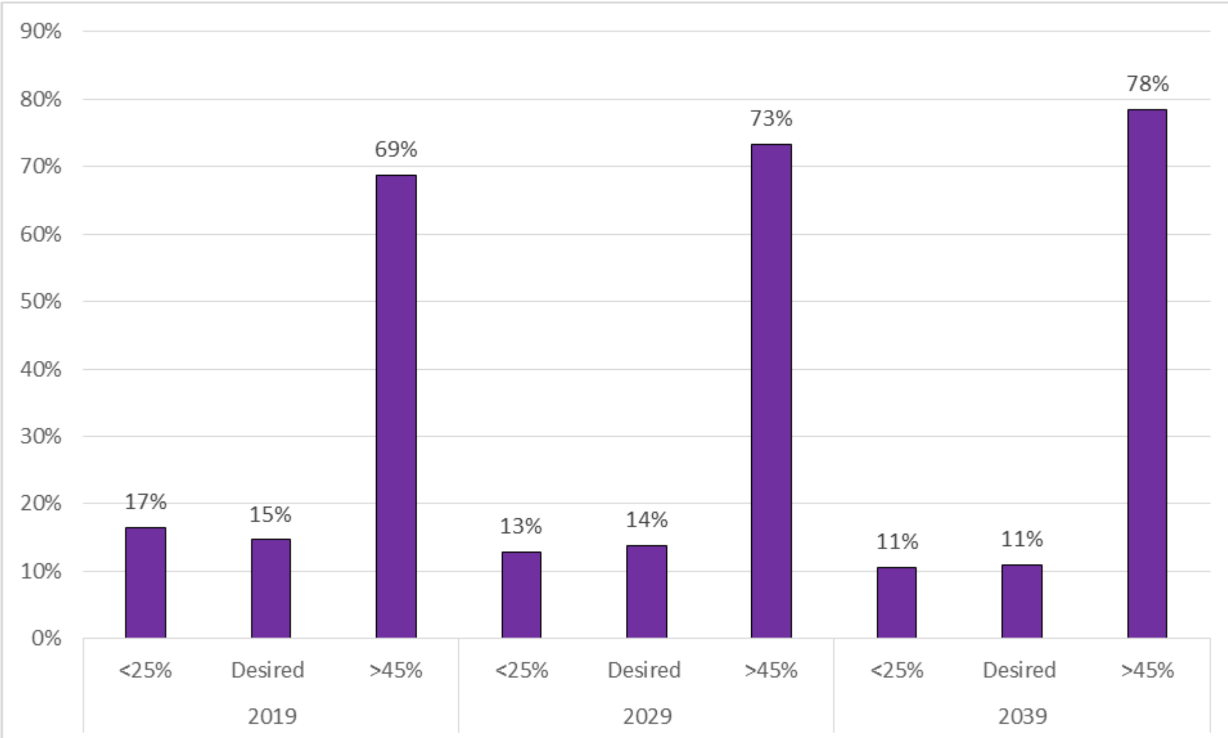


Figure 20. Alternative 1 - No Action – Percent of stands meeting the desired condition for stand density index

Large Tree and Old Tree Structure

Stands of post settlement trees where the quadratic mean diameter of the top 20 percent of trees is greater than 15"and the basal area of trees greater that 16" is more than 50 feet of basal area can be considered stands with a preponderance of large young trees (SPLYT stands). These stands occur outside of MSO PACs, MSO Recovery habitat and WUI and are being identified for their distinctive forest structure.

Under this alternative, no trees would be removed through cutting. Therefore, all large and old trees are expected to remain, except they are likely to be more susceptible to mortality from drought, pests, and disease as well as wildfire (Das et al. 2011, Ritchie et al, 2008). Across all 5th HUC watersheds in the analysis area the number of acres meeting SPLYT criteria is currently estimated to be 36,265 acres with a QMD of the top 20 percent of trees to be 19 inches. This number would increase to 80,139 acres by 2039 with a QMD of the top 20 percent of trees remaining at 19 inches. This is the result of current trees continuing to increase in diameter growth and does not take into account the potential mortality from drought, insects, disease and wildfire.

This alternative would also result in higher risk of mortality, especially for larger trees, because of an increasing risk of infection from pests or disease (Fischer et al, 2010), high severity or uncharacteristic wildfire (Coop et al, 2016) (Fiedler et al, 2010), or increased drought stress from competition (Erickson & Waring, 2014). A number of studies have found that higher forest density leaves large and old trees more susceptible to mortality. Erickson and Waring (2014) concluded that, "treatments removing small, neighboring trees may be critical in maintaining old ponderosa in the landscape, particularly under future climate change and increasing drought frequency in the western USA." Modifying forest conditions to facilitate low severity fire on the landscape has been identified as a key condition to preventing increased mortality of large and old trees over the next several decades (Fiedler et al. 2007, Kolb et. al. 2007, Ritchie et. al. 2008). Thus, while this alternative may increase the amount of large and old trees based on model results, these results do not account for the likely substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristically severe wildfire), which would decrease the amount of old and large trees in the analysis area.

Under this alternative it is possible that one or more naturally caused wildfires would be managed to benefit forest resources. Depending on the ability to manage one or more naturally caused fires based on values at risk, fuel, and weather conditions under this alternative some wildfires could result in small openings that decrease areas of intermediate aged trees, which would then contribute to establishment of a new young cohort of trees. Management of naturally caused fires under this alternative may also have the effect of reducing basal area and SDI by killing small trees or groups of small and/or intermediate aged trees. These fires could also result in mortality of some large and old trees or large patches of high severity mortality. Based on those areas in recent wildfires that have been managed for resource benefits, this effect may be very limited across the landscape. The current condition of the Forest would limit the ability to manage naturally-occurring wildfires in the analysis area at low to moderate-intensity levels without potential unacceptable effects on values at risk.

Forest Process

Insects

Under the No Action Alternative the proportion of acreage with a high hazard rating for bark beetles would increase from 74 percent to 82 percent, a considerable majority of the landscape. The proportion of acreage with a low or moderate hazard rating would decrease. Some large watersheds such as Upper Clear Creek, Haigler Creek-Tonto Creek and East Verde River are currently over 90 percent high hazard for bark beetles. The existing condition is departed from the desired condition and would further depart between 2019 and 2039 as basal area and SDI continue to increase beyond the Desired Condition.

Drought, coupled with high tree densities, can lower resistance to beetle attacks. Bark beetle population dynamics suggest that homogenous, dense, even-aged stands are highly susceptible to beetle outbreaks. Susceptibility to western pine beetle would slowly increase over time. Areas with the greatest likelihood of infestation are those stands with densities greater than 120 square feet of basal area and average stand diameters greater than 12 inches dbh. Susceptibility to ips beetles would continue to increase with activity most likely occurring in response to a drought or a snow or ice event that creates fresh pine debris.

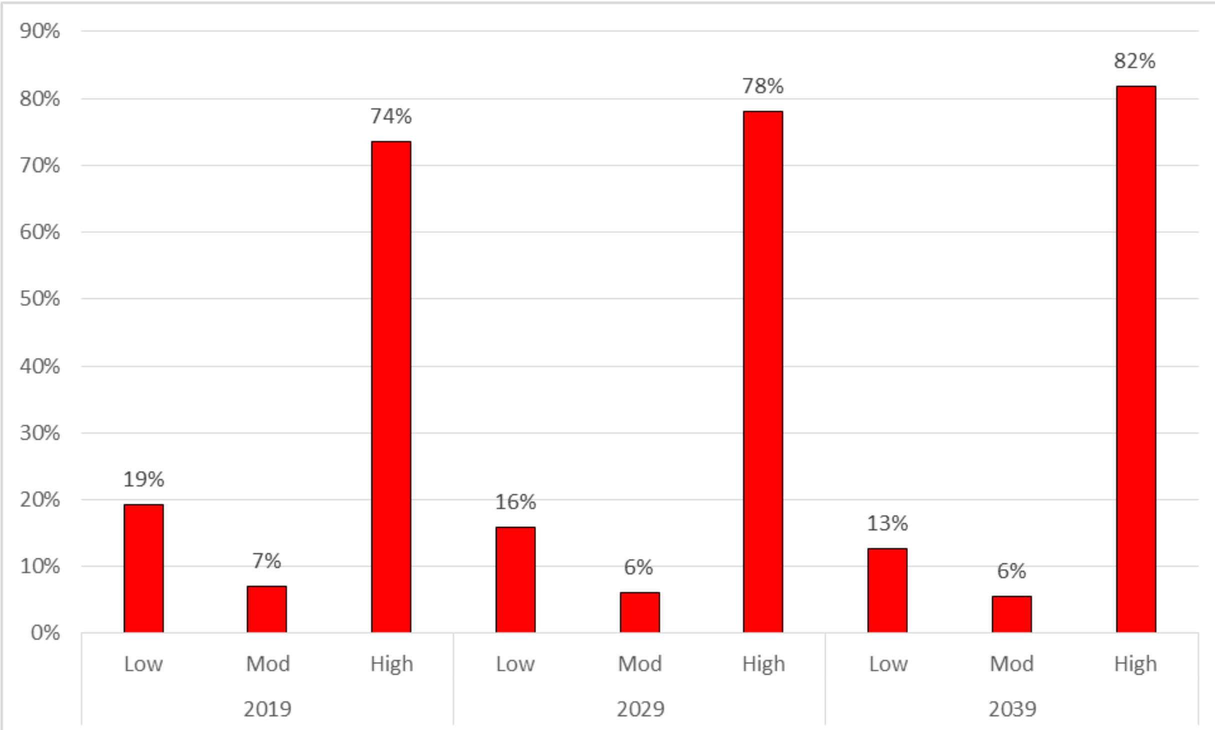


Figure 21. Alternative 1 - No Action Alternative – Distribution of bark beetle hazard rating classes across the analysis area

Disease

Across the analysis area, approximately 75 percent of the area is not infected or has a low infection level, 22 percent has a moderate severity rating and 4 percent has a high severity rating. This distribution shifts to higher severity ratings over time; by 2039, 25 percent of acres are classified as moderate and 9 percent of acres are classified as severe by 2039. This is an indication that mistletoe infection is intensifying and spreading over time. Dwarf mistletoe infections would not be reduced and may intensify in infected trees and the surrounding trees, reducing the growth, vigor, and longevity of ponderosa pine. (Conklin 2000). Though most of the analysis area meets the desired condition of having a low or no dwarf mistletoe severity, 34 percent of the analysis area would have a moderate or severe dwarf mistletoe severity rating by 2039 and would not meet the desired condition. Stands would further depart from the desired condition over time as infected stands intensify their infections and infect adjacent areas (Conklin and Fairweather 2010).

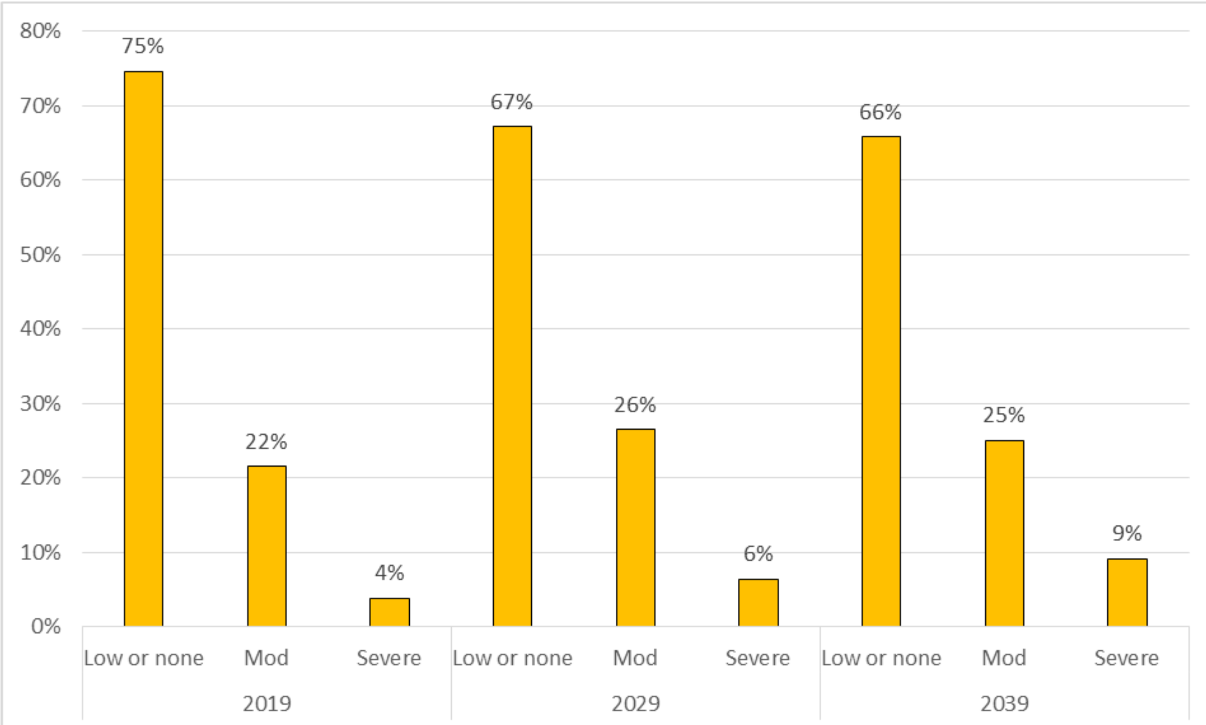


Figure 22. Alternative 1 - No Action Alternative – Dwarf Mistletoe severity rating classes across the analysis area

Fire Adaptation

For a more thorough discussion of this alternative in terms of fire adaptation, consult the Fire Ecology Specialist Report (USDA 2019). In general, this alternative does not support the purpose and need to develop or return to a forest ecosystem that is fire-adapted, resilient, diverse, and sustainable. This alternative would continue to support the current shift away from frequent, low severity surface fires to conditions that are more likely to support increasingly larger high severity crown fires (Cooper 1960) (Swetnam 1990) (Covington and Moore, 1994a) (Kolb et al 1994) (Swetnam and Baisan, 1996). The current forest structure is quite different from conditions from the NRV of the native microbes, plants, and animals living in western ponderosa pine and dry mixed conifer forests (Covington and Moore 1994a, Reynolds et al 2013). As a result, this project area would remain susceptible to undesirable fire behavior and effect, and other disturbance agents, such as bark beetles and disease, over time.

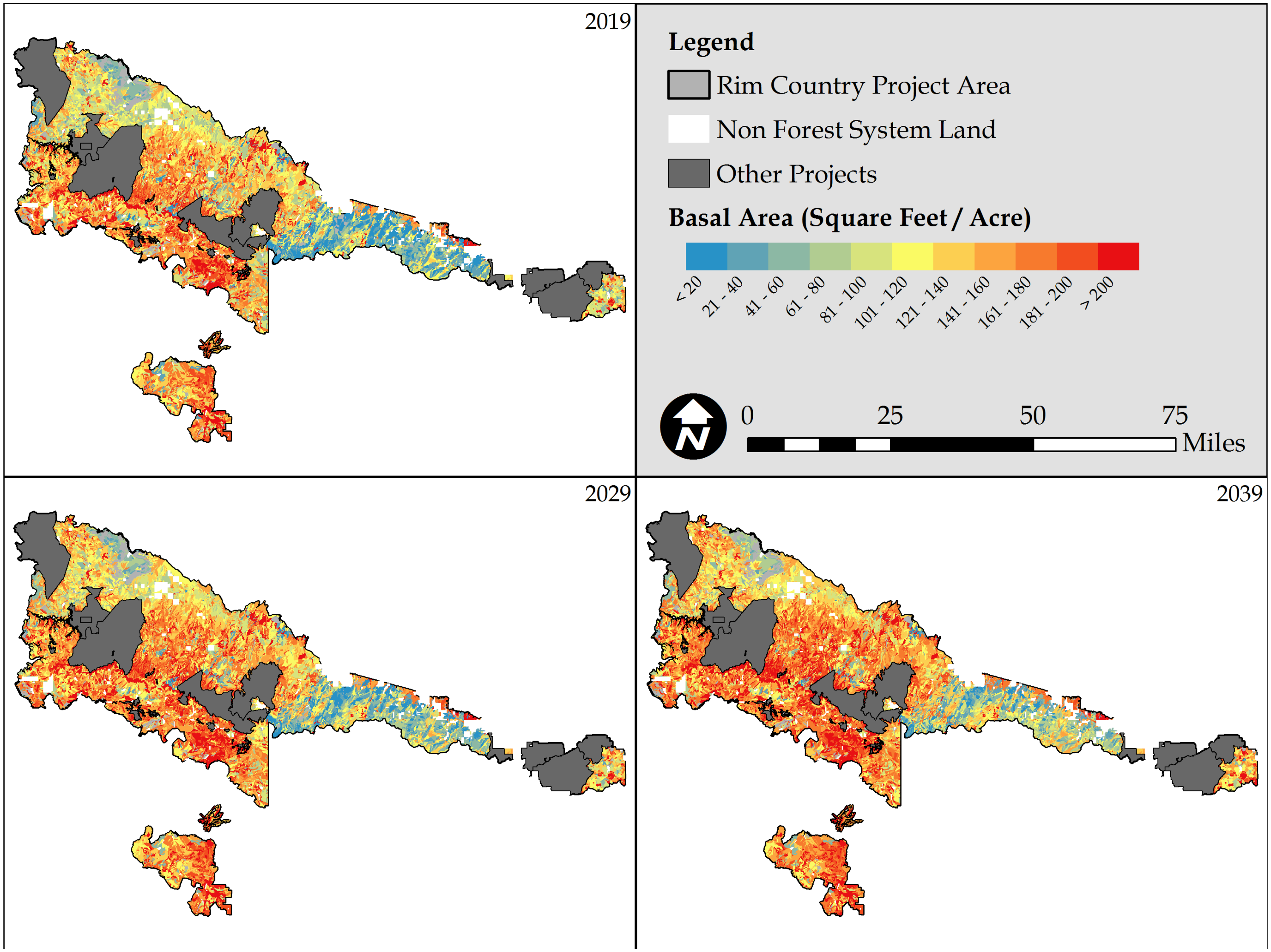


Figure 23. Alternative 1 – basal area

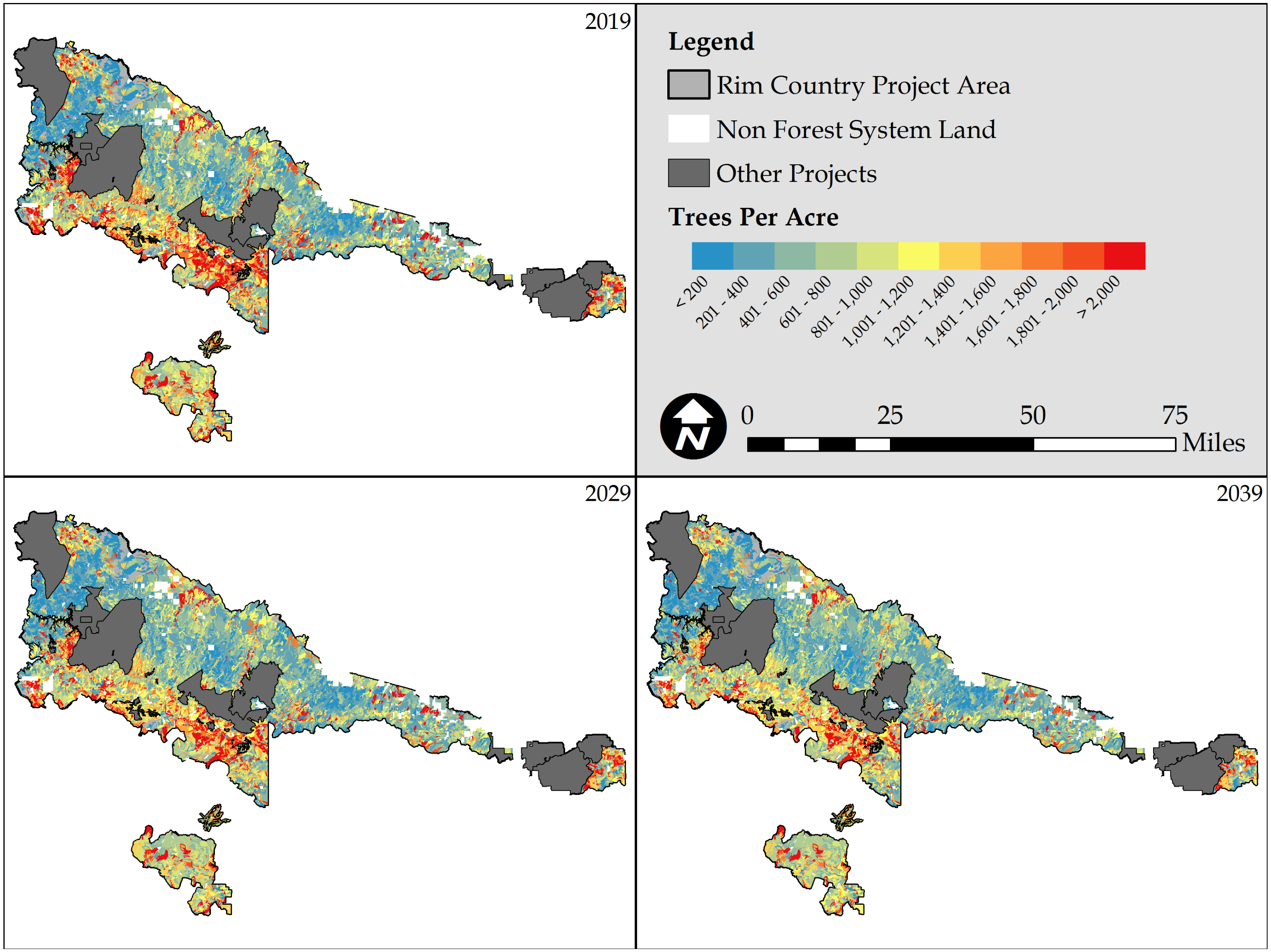


Figure 24. Alternative 1 –trees per acre

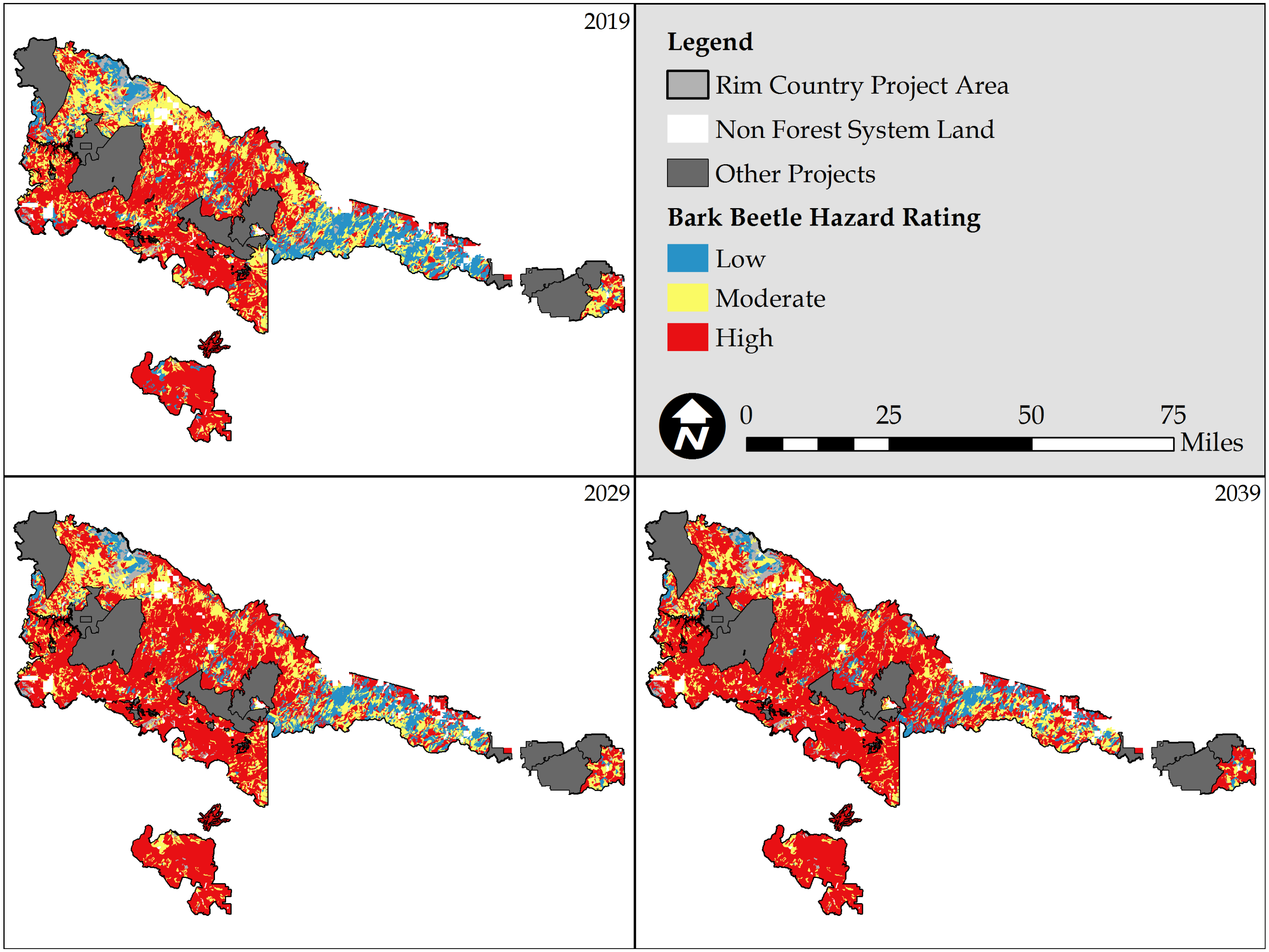


Figure 25. Alternative 1 – bark beetle hazard rating

Alternative 2 – Modified Proposed Action

Direct and Indirect Effects

Under Alternative 2, prescribed cutting and/or prescribed fire treatment would be applied in order to move towards or meet the desired conditions. This alternative meets or moves the project area toward the desired conditions identified in the Forest Plans and moves the project area forward in initiating the re-establishment of a fire-adapted, resilient, diverse, and sustainable forest ecosystem. The distribution of trees across size classes is more representative of a historic size class distribution as many trees in the smaller size classes have been removed or burned. At a landscape scale forest composition, structure, pattern, and process would all be improved.

Composition

Forest composition would improve under this alternative. Ponderosa pine would still be the dominant forest cover type. Mixed conifer would continue to make up a moderate proportion of the analysis area. As a result of prescribed cutting and prescribed fire, prevalence of later seral species such as white fir and corkbark fir in forested stands would be reduced and would better represent their role in the NRV. Pinyon juniper woodlands and oak species would continue to make up a considerable part of the analysis area. The treatment of conifer encroached grasslands would expand their range to more fully represent the Desired Condition to reestablish their historical extent. The protection and improvement of aspen stands would promote regeneration and reduce inter-tree competition and improve their condition under this alternative; however aspen is one of the species predicted to be most affected by a changing climate. The condition of less common but important species such as maple and Emory oak would be improved through the cutting of other species such as juniper and other species.

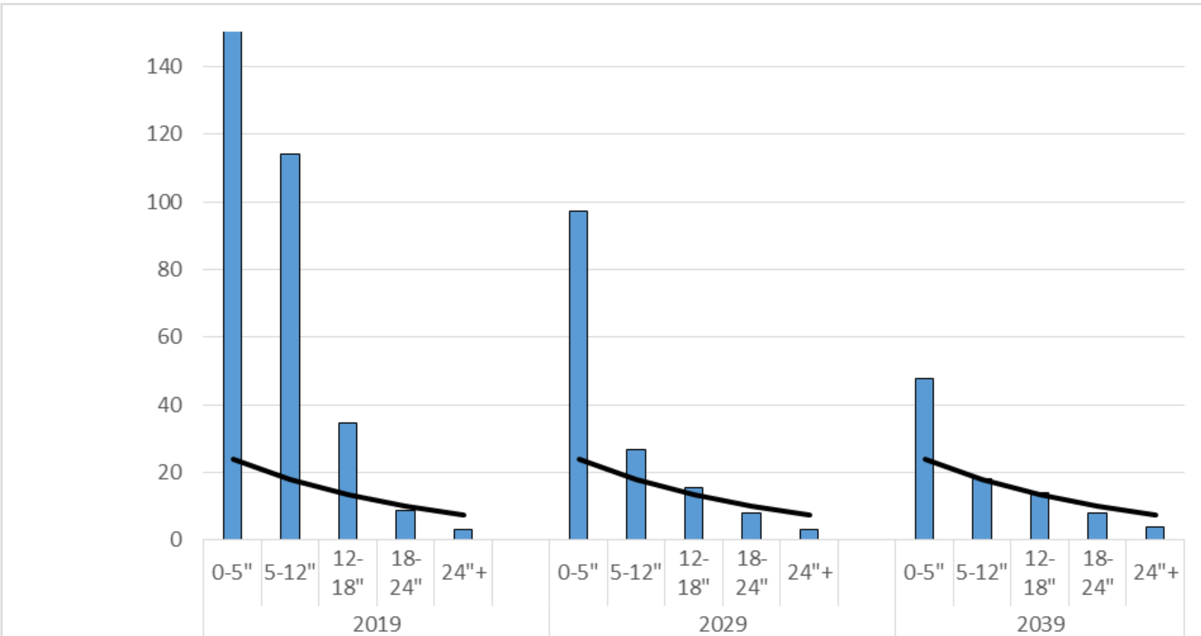
This analysis has considered the effects of a changing climate. Though this alternative would result in a landscape more resilient to climate change, climatic models for the southwestern U.S. predict continued warming, greater variability in precipitation, and increased drought. These climatic changes would likely contribute to some level of tree mortality; however, considerably less than the No Action Alternative. A changing climate may lead to large shifts and contractions in the range of dominant trees throughout much of the region (Kane et al, 2014).

Structure

Uneven-aged Structure

Uneven-aged forest are defined as forests composed of three or more distinct age classes of trees, either intimately mixed or in small groups. The Desired Condition is for uneven-aged forest structure to occur on a majority of acres. Under this alternative, there is considerable change to forest structure (Figure 3-12). Across the project, even-aged structure would dominate the landscape with a balance of trees in smaller, medium and larger size classes. The proportion of stands with uneven-aged structure would increase into the future. This alternative would meet the Desired Condition for uneven-aged structure in the Forest Plans and forest structure would more closely resemble the NRV. Modeling indicates that some stands would move towards more even-aged conditions in the dominant cover types proposed for treatment as a result of removal of trees from the smaller size classes and retention of trees in the larger size classes. Modeling the most intense extent of the range of the prescribed treatment, combined with the protection of large and old trees, produced even-aged stands of larger trees in some cases. However, as treatments are applied on the ground, the use of the large and old tree implementation plans, in accordance with an uneven-aged thinning strategy, would be able to produce uneven-aged conditions across much of the landscape. Individual tree growth would increase and trees would move into larger size classes as a result of a reduction in individual tree competition. Naturally-occurring regeneration would provide additional vertical structure over time.

An additional, and potentially more substantial, benefit to forest structure would be a reduction in the possibility of an uncharacteristic wildfire or other substantial disturbance event, such as a beetle outbreak or long-term drought. Under this alternative stands would be more resistant to uncharacteristic fire and insect outbreaks and more resilient to drought. The balance of size classes and uneven-aged structure would provide conditions favorable to restoration of a natural fire regime.



	2019					2029					2039				
	0-5"	5-12"	12-18"	18-24"	24"+	0-5"	5-12"	12-18"	18-24"	24"+	0-5"	5-12"	12-18"	18-24"	24"+
Alt 2	813	114	35	9	3	97	27	15	8	3	48	18	14	8	4
Idealized	24	18	14	10	8	24	18	14	10	8	24	18	14	10	8

Figure 26. Alternative 2 – Proposed Action – Distribution of trees per acres across size classes across the analysis area

Density

Measure of density in this analysis include trees per acre, basal area and stand density index. With prescribed thinning and fire, there would be considerable change to the size class distribution in the near future. The Proposed Action would effectively meet the desired condition for trees per acre with a balance across size classes. The overall tree density would decrease considerably under this alternative, from 973 in 2019 to 151 in 2029 and 92 by 2039.

While the initial reduction in trees per acre would result from a combination of mechanical and prescribed fire activities, the reduction after 2029 can be attributed to the recurring prescribed fires over time. Prescribed fires with higher or lower severity (e.g., burning under hotter or cooler and/or wetter conditions) from 2029 to 2039 could be implemented to maintain a higher or lower number of trees per acre in the smaller size classes if desired. The reduction in tree density would increase individual tree growth and reduce density dependent tree mortality. Understory grasses, forbs herbs and shrubs would increase in quantity (Covington & Moore 1994a).

The desired condition is to retain a basal area of between 30 to 90 square feet per acre across most habitat types outside of MSO PACs. While the Forest Plans provide a desired condition with a range of basal areas ranging from 20 to 180 square feet per acre depending on cover type, for this analysis, at the project level, for ease of comparison of effects between alternatives, 90 square feet per acre is the breakpoint for the resource measure across the analysis area. For both mixed conifer and ponderosa pine cover types it is desired to maintain basal area at less than 90 square feet per acre though exceptions exist to provide heterogeneity across the landscape as well as specific wildlife needs for dense and closed canopy forest conditions. For a more thorough analysis of the effects of this alternative within MSO and Northern goshawk habitat, consult the Wildlife Specialist Report (USDA 2019).

Under the Modified Proposed Action alternative, basal areas across the analysis area would average 65 square feet in 2029 and 62 square feet in 2039. While currently only 19 percent of stands meet the desired condition, by the year 2029, 58 percent of stands would have met the desired condition, and by 2039, over 56 percent of stands would meet the desired condition. This would result in decreased inter-tree competition for resources such as water, light, growing space, and nutrients. Individual tree growth would increase and density dependent mortality would be dramatically reduced along with susceptibility to potential insect and disease outbreaks. These conditions would indicate a shift from the current larger and higher severity crown fires that the forest would currently experience to cooler, higher frequency, lower severity surface fires (Cooper 1960) (Swetnam 1990) (Covington & Moore, 1994a) (Kolb et al 1994) (Swetnam and Baisan 1996) that persisted prior to European settlement. The reductions in basal area would meet the desired condition and purpose and need for fire-adapted, resilient, diverse, and sustainable forest ecosystems at the landscape and watershed scales.

While all watersheds would have their average basal areas reduced to within the desired condition, some watersheds such as Gun Creek-Tonto Creek and Rye Creek-Tonto Creek would experience considerable additional mortality as a result of prescribed fire between 2029 and 2039. Prescribed fires with lower severity effects (e.g., burning under cooler and/or wetter conditions) in 2029-2039 could be implemented to maintain the desired basal area and continue to meet the desired condition.

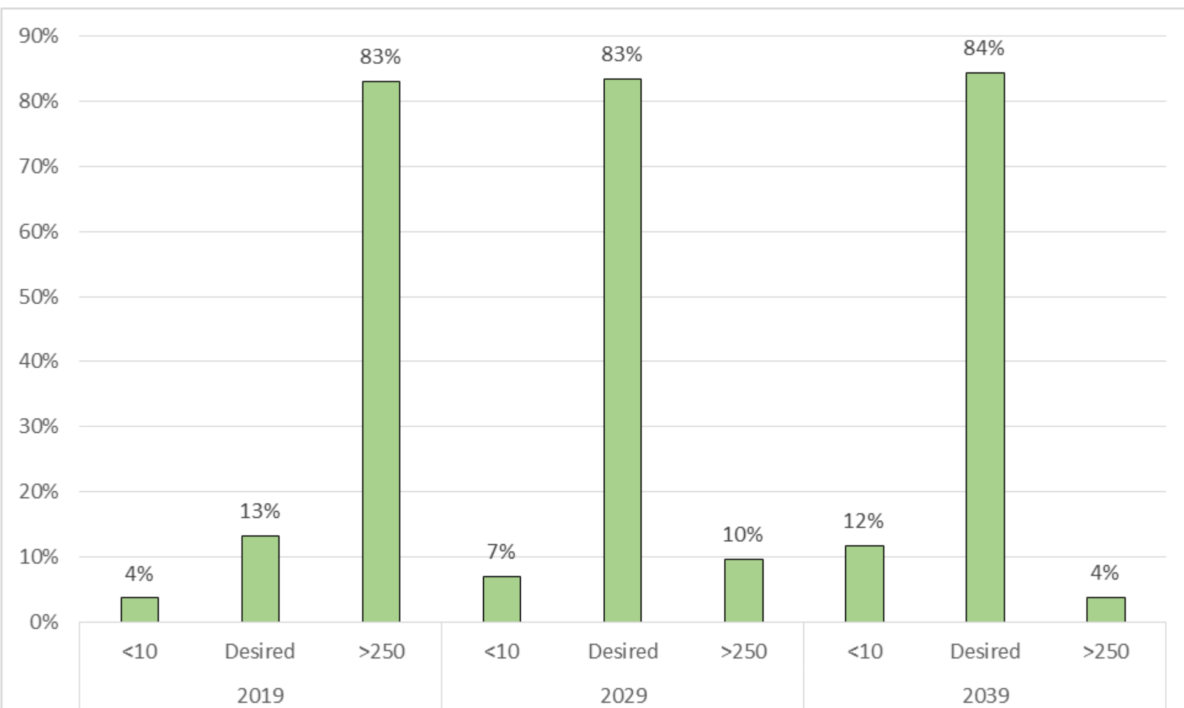


Figure 27. Alternative 2 – Proposed Action – Percent of acres meeting desired condition for trees per acre across the analysis area

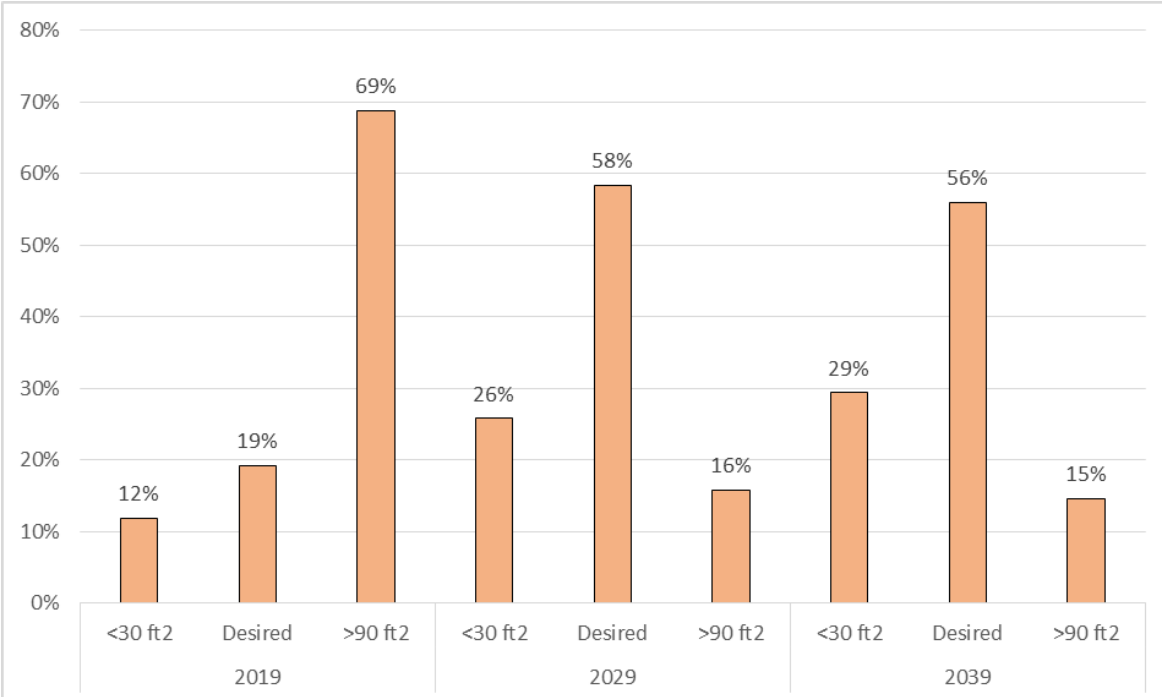


Figure 28. Alternative 2 - Proposed Action – Percent of acres meeting desired condition for basal area across the analysis area.

Stand Density Index (SDI) is a measure of relative stand density based on the number of trees per acre and the mean diameter (Reineke 1933, Long 1995). Percent SDImax expresses the actual density in a stand relative to a theoretical maximum density possible for trees of that diameter and species. SDI is a good indicator of how site resources are being used by taking both average tree size and trees per acre into account. SDImax represents an empirically-based estimate of the maximum combination of quadratic mean diameter and density which can exist for any stand of a particular forest type.

The desired condition for SDI is to be between 25 and 45 percent of SDIMax or between 112.5 and 202.5. Currently across the analysis area, SDI averages 296 or 66 percent of SDImax and is considered extremely high. As a result of the proposed action, SDI would be reduced to 116 or 26 percent of SDIMax by 2029 and 103 or 23 percent of SDIMax by 2039. While the proportion of acres meeting desired condition in 2019 is 15 percent, the proportion meeting the desired condition would increase to 27 percent in 2029 and to 21 percent by 2039. Prescribed fires with lower severity effects (e.g., burning under and/or wetter conditions) from 2029 to 2039 could be implemented to maintain a higher or SDI if desired. SDI values between 25 percent and 45 percent of SDIMax are associated with high understory production and intermediate levels of individual tree diameter growth as overall stand growth is concentrated on fewer number of trees than in more dense forests. Depending on the level of tree aggregation, little inter-tree competition would be occurring. Competition could still be occurring within dense tree groups.

Over time, with the proposed action, stand densities should stabilize as the reintroduction of fire returns natural disturbance processes to the landscape. This would result in reduced susceptibility to insect epidemics, particularly bark beetles, as well as reduced density dependent mortality, increased individual tree diameter growth and forage production over time, and continued attainment of the desired condition.

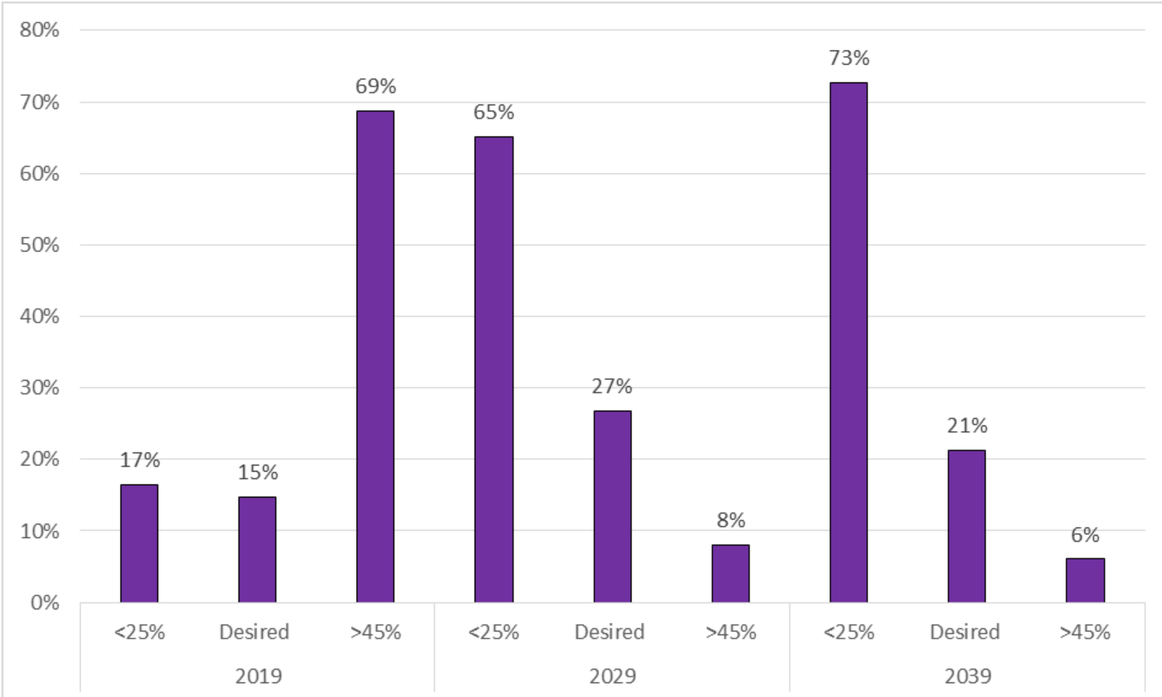


Figure 29. Alternative 2 - Proposed Action – Percent of stands meeting the desired condition for stand density index

Large Tree and Old Tree Structure

Stands of post settlement trees where the quadratic mean diameter of the top 20 percent of trees is greater than 15"and the basal area of trees greater that 16" is more than 50 feet of basal area can be considered stands with a preponderance of large young trees (SPLYT stands). These stands occur outside of MSO PACs, MSO Recovery habitat and WUI and are being identified for their distinctive forest structure.

Across all 5th HUC watersheds in the project area, the average number of acres currently meeting SPLYT criteria is 36,325 with a QMD of the top 20 percent of trees being 19 inches. Under the proposed action, this number would increase to 64,774 acres with a QMD of the top 20 percent of trees being 24 inches. While this acreage is lower than the acres meeting SPLYT criteria in 2039 for the no action alternative it does not take into the account the potential large scale mortality of trees as a result of a large fire or insect outbreak. Under this alternative, prescribed cutting and prescribed burning would occur over much of the landscape. Modeling indicates that the number of acres meeting SPLYT criteria would increase as a result of the proposed action, but at a slower rate than the Proposed Action. With design features in place during implementation, large trees meeting the large and old growth tree implementation plan criteria would be retained, resulting in more large trees being left at the expense of smaller tree sizes. This would allow the number of SPLYT acres to increase over time. During implementation, some large trees would be cut in accordance with the large and old growth tree implementation plans. Remaining larger trees would be less susceptible to mortality from drought, insects, disease, and wildlife (Das et al. 2011, Ritchie et al, 2008). This reduction in the number of SPLYT acres over the no action alternative does not take into account the application of the LTIP that would effectively increase the number of large trees remaining across the landscape.

This alternative would result in a lower risk of mortality, especially for larger trees, because of a decreasing risk of infection from pests or disease (Fischer, Waring, Hofstetter, & and Kolb, 2010), high severity or uncharacteristic wildfire (Coop et al, 2016) (Fiedler et al, 2010), or increased drought stress from competition (Erickson & Waring, 2014). A number of studies have found that lower forest density leaves large and old trees less susceptible to mortality as a result of these factors. Erickson and Waring (2014) concluded that, "treatments removing small, neighboring trees may be critical in maintaining old ponderosa in the landscape, particularly under future climate change and increasing drought frequency in the western USA." Modifying forest conditions to facilitate low severity fire on the landscape has been identified as a key condition to preventing increased mortality of large and old trees over the next several decades (Fiedler et al. 2007, Kolb et. al. 2007, Ritchie et. al. 2008). While this alternative may increase the amount of SPLYT acres at a slower rate than the No Action Alternative, the resulting forest would be far less likely to experience substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristic wildfire). A potential result of this alternative would be additional SPLYT acres than the No Action alternative in the presence of large scale disturbances.

Under this alternative, Forests would be able to manage more acres of naturally occurring wildfires for resource benefit. Forest structure, including openings, interspace, and groups and clumps of trees would allow for low to moderate fire severity that would maintain openings and have little potential effect on the vegetation resource except for trees in the smaller size classes. For a more thorough description of post treatment fire behavior consult the Fire Ecology Specialist Report in the project record.

Forest Process

Insects

Under the Modified Proposed Action, the proportion of acreage with a high hazard rating for bark beetles would decrease from 74 percent to 11 percent in 2029 and to 8 percent by 2039. Stands with a low or moderate beetle hazard rating, the desired condition, would increase from 26 percent in 2019 to 89 percent in 2029 and then 92 per cent by 2039. This demonstrates a considerable shift towards the desired condition for this indicator. While the proportion of acreage with a moderate rating would change only slightly, the proportion of acreage with a low hazard rating would increase considerably as the analysis area approaches desired condition for this indicator.

Stands with lower tree densities and basal area are more resilient to drought and beetle attacks. Bark beetle population dynamics suggests that homogenous, dense stands are highly susceptible to beetle outbreaks. The proposed action would create heterogeneous, open, uneven-aged stands that would dramatically reduce susceptibility and maintain that reduced susceptibility over time. Susceptibility to western pine beetle would decrease over time with mechanical treatment and reintroduction of low severity surface fire. Areas with the greatest likelihood of infestation from bark beetles are areas treated at a low intensity as to not considerably affect beetle hazard rating. Additionally, areas with large amounts of slash remaining post treatment are at risk for ips beetles. Some susceptibility to ips would continue to increase, with activity most likely occurring in response to a drought or a snow or ice event that creates fresh pine debris.

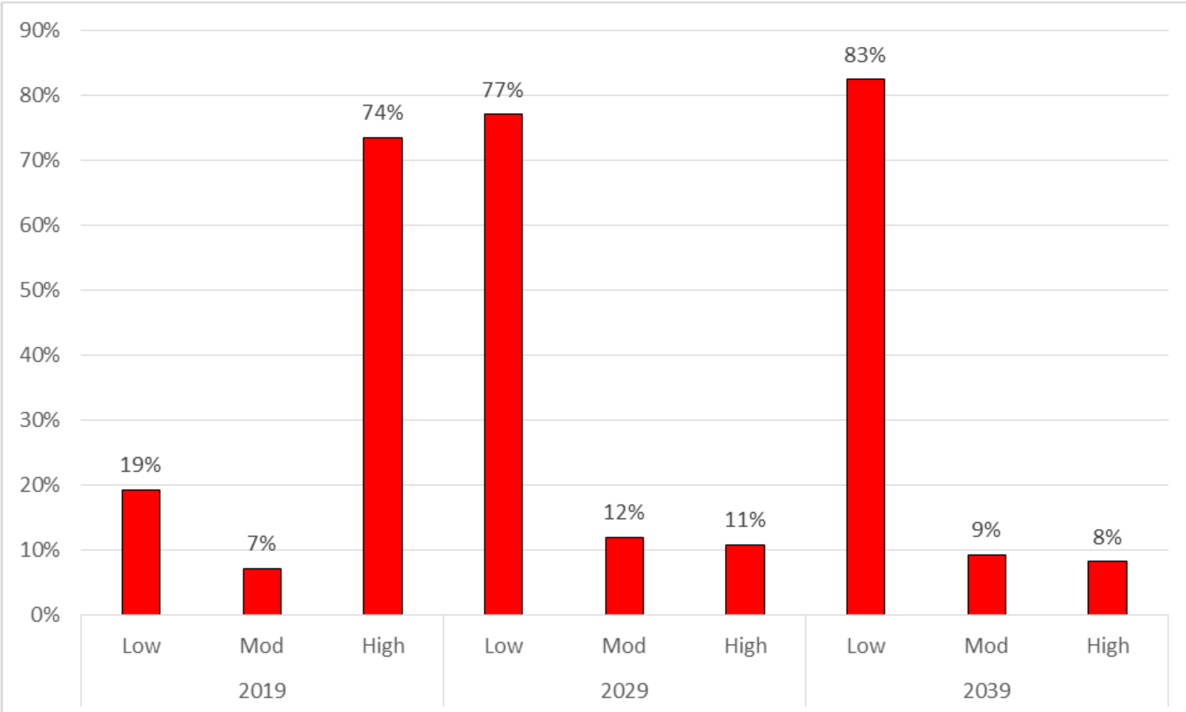


Figure 30. Alternative 2 - Proposed Action – Distribution of Bark Beetle Hazard Rating classes across the analysis area.

Disease

Across the analysis area, approximately 75 percent of the area would not be infected or have a low infection level, 22 percent would have a moderate severity rating, and four percent, or 36,058 acres, would have a high severity rating. As a result of the Modified Proposed Action, stands with a high severity rating would drop to two percent and stands with a Low or None rating drop to 69 percent. Acres with a moderate rating would increase to 31 percent as infection intensification and spread occur even after mechanical treatment. Dwarf mistletoe infections may be reduced as a result of the Proposed Action but may intensify in remaining or latent infected trees, surrounding trees, and infected residual overstory trees, reducing the growth, vigor and longevity of ponderosa pine (Conklin and Fairweather 2010). However, across the analysis area, growth, longevity, and vigor of ponderosa pine trees would be increased. Though most of the analysis area would meet the desired condition of having low or no dwarf mistletoe severity, 34 percent of the analysis area would have a moderate or severe dwarf mistletoe severity rating by 2039 and would not meet the desired condition. This would be an improvement in dwarf mistletoe severity rating over the No Action Alternative by the year 2039.

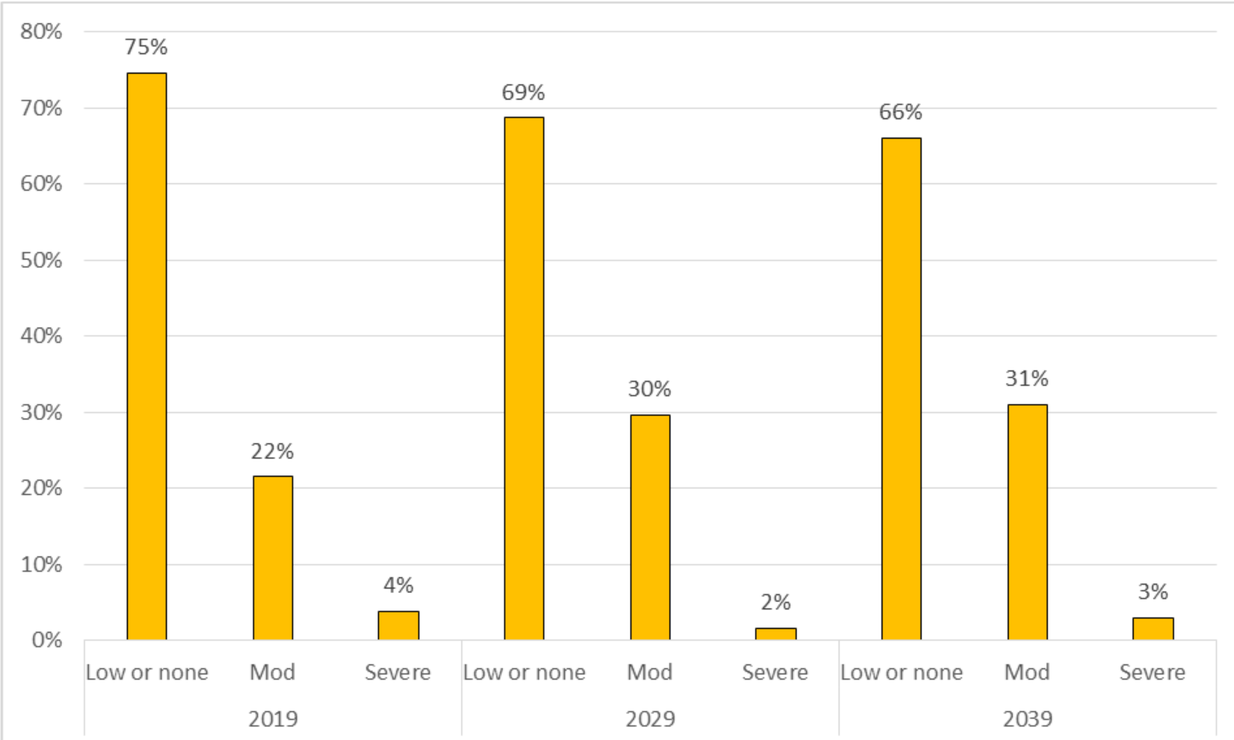


Figure 31. Alternative 2 - Proposed Action – Dwarf Mistletoe Severity Rating classes across the analysis area

Fire Adaptation

For a more thorough discussion of this alternative in terms of fire adaptation, consult the Fire Ecology Specialist Report (USDA 2019). In general, this alternative would support the purpose and need to develop or return to a forest ecosystem that is fire-adapted, resilient, diverse, and sustainable. This alternative would support the shift away from larger high severity crown fires to conditions that are more likely to support increasingly frequent, low severity surface fires (Cooper 1960) (Swetnam 1990) (Covington and Moore, 1994a) (Kolb et al 1994) (Swetnam and Baisan, 1996). Over time this alternative would create conditions that resemble the NRV of the native microbes, plants, and animals living in western ponderosa pine and dry mixed conifer forests (Covington and Moore 1994a, Reynolds et al 2013). As a result, the analysis area would have reduced susceptibility to undesirable fire behavior and effects as well as other disturbance agents, such as bark beetles and disease, over time.

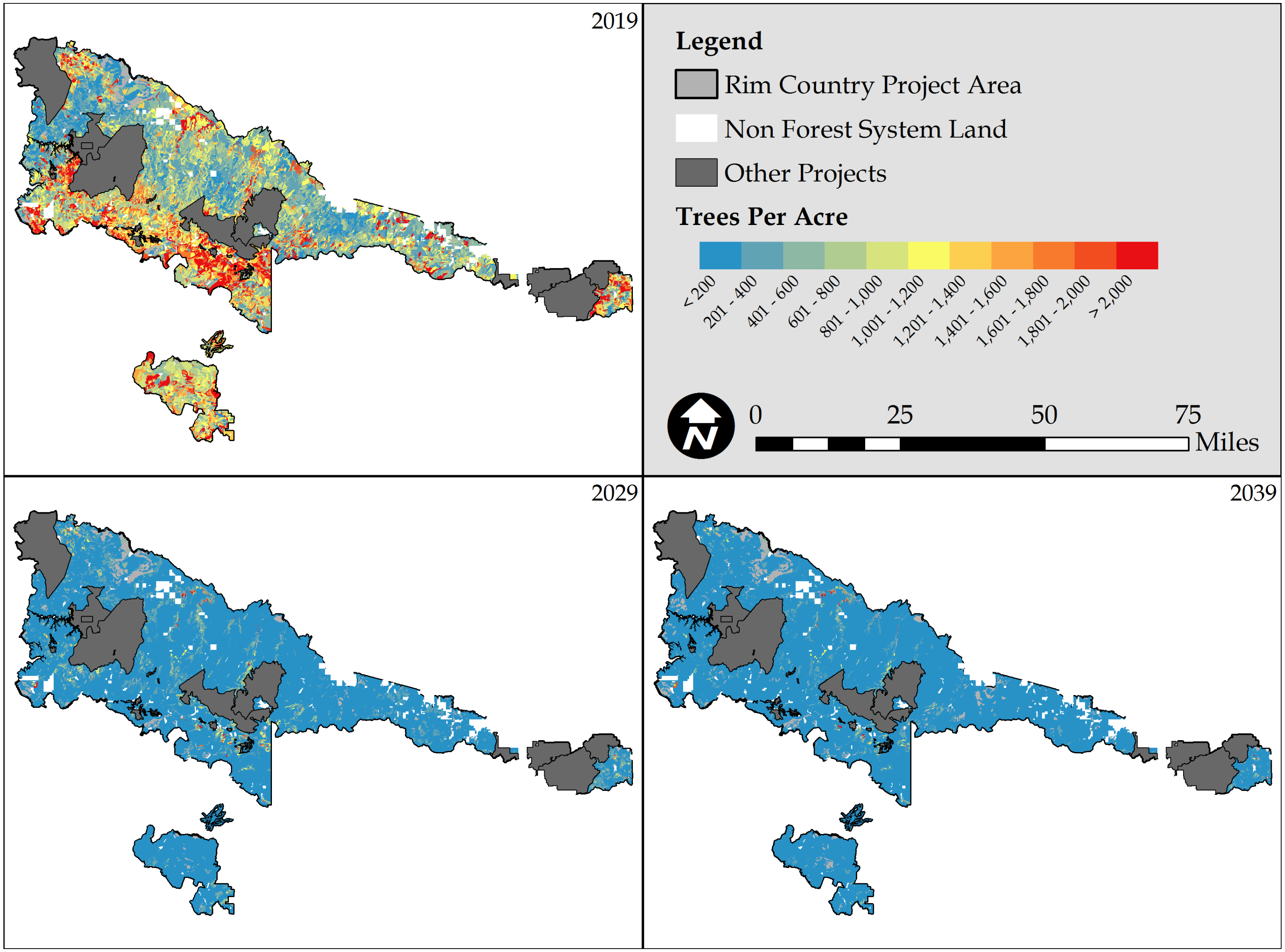


Figure 32. Alternative 2 – trees per acre

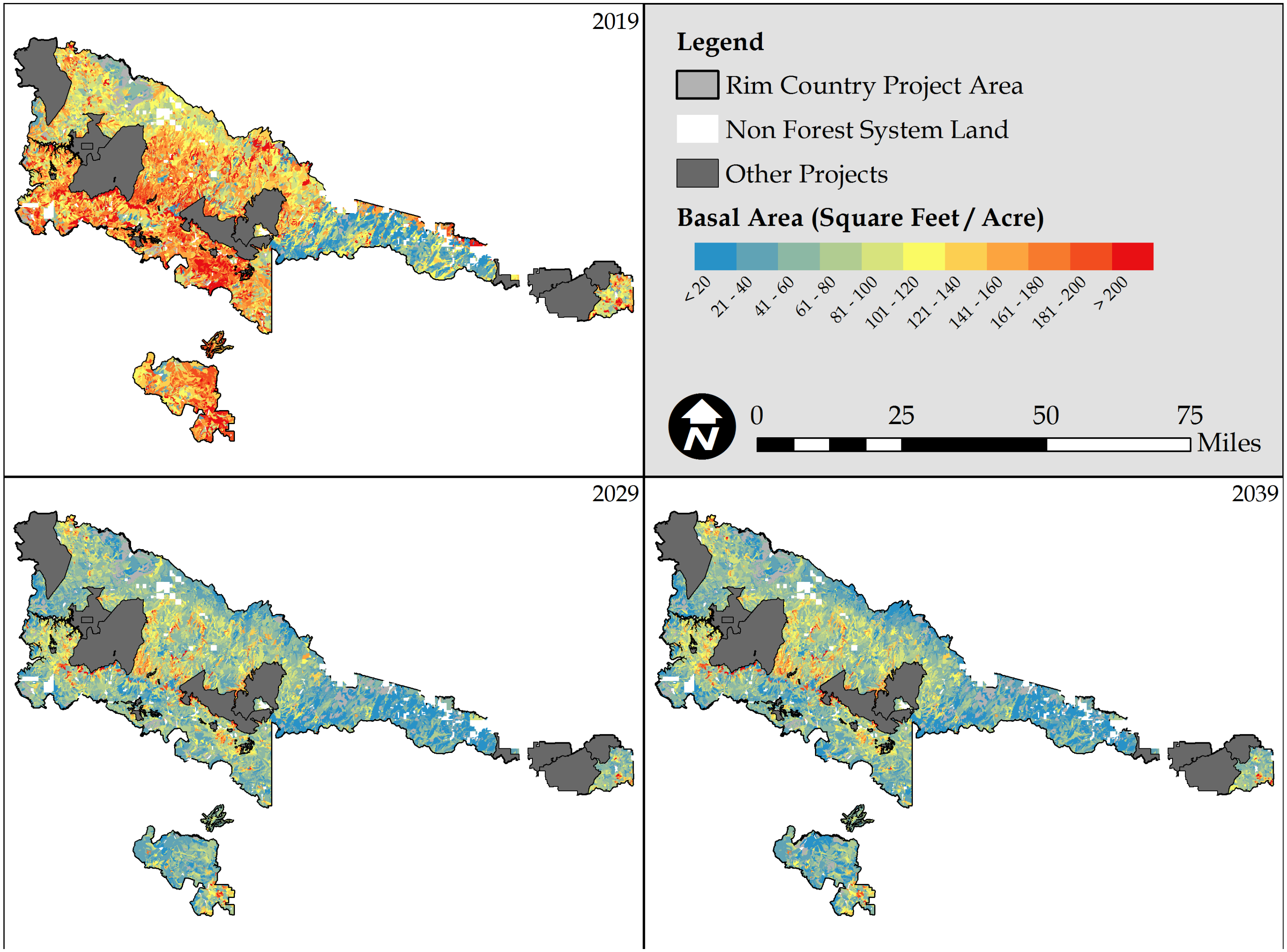


Figure 33. Alternative 2 – basal area

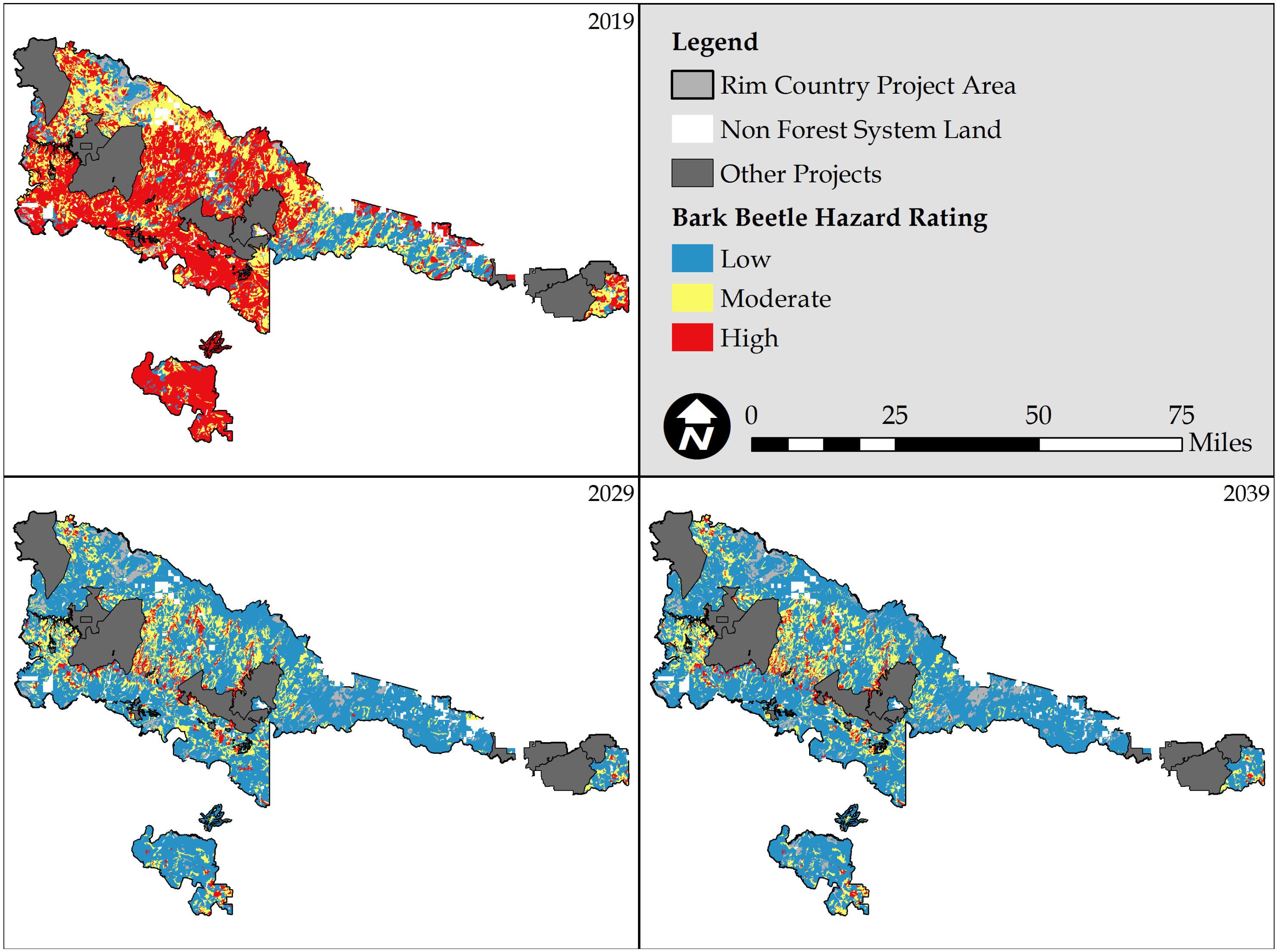


Figure 34. Alternative 2 – bark beetle hazard rating

Alternative 3 – Focused Restoration

Direct and Indirect Effects

In general, many of the direct and indirect effects of Alternative 3 would fall somewhere between those of the Alternative 1 and Alternative 2 or similar to Alternative 2 with somewhat muted effects due to the limited number of acres treated. Under Alternative 3, prescribed cutting and/or prescribed fire treatment would be applied over a portion of the analysis area in order to move towards or meet the desired conditions. This alternative meets or moves the project area toward the desired conditions identified in the Forest Plans and moves the project area forward in initiating the re-establishment of a fire-adapted, resilient, diverse, and sustainable forest ecosystem over the portion of the project area that would be treated. For a more thorough analysis of the effects of this alternative on the wildfire hazard, consult the Fire Ecology Specialist Report (USDA 2019). Many other areas that did not receive treatment would not move toward the desired conditions identified for this project. The distribution of trees across size classes is more representative of a historic size class distribution as many trees in the smaller size classes have been removed or burned. At a landscape scale, forest composition, structure, pattern, and process would all be improved, but to a lesser extent than the Proposed Action.

Stand and landscape resilience to disturbances such as multi-year drought, pests and disease such as bark beetle and mistletoe, and wildfire would increase (Abella, et al. 2007), although to a lesser extent than with the Proposed Action. Drought stress and insect attacks associated with increased tree density, altered tree spatial arrangement, would be reduced. These changes in forest structure would reduce tree mortality due to decreased competition among trees in stands that were treated (Kane et al 2014). At the fine scale, forest structure and pattern would be improved in treated areas as vegetation management activities would maintain or improve the level of tree aggregation (groups and clumps of trees), and as existing groups are maintained and new groups are created (Zhang et al 2013).

Composition

Forest composition would improve under this alternative, although to a lesser extent than the Proposed Action. Ponderosa pine would still be the dominant forest cover type. Mixed conifer would continue to make up a moderate proportion of the analysis area, however shade tolerant species such as white fir may increase compositionally in untreated stands. As a result of prescribed cutting and prescribed fire in areas proposed for treatment, prevalence of later seral species such as white fir and corkbark fir would be reduced and would better represent their role in the NRV. Pinyon Juniper woodlands and oak species would continue to make up a considerable part of the analysis area. The treatment of encroached grasslands would expand their range to more fully represent the NRV, although to a lesser extent than the Alternative 2. The protection and improvement of aspen stands would promote regeneration and reduce inter-tree competition and improve their condition under this alternative. The condition of less common but important species such as maple and Emory oak would be improved in treated areas.

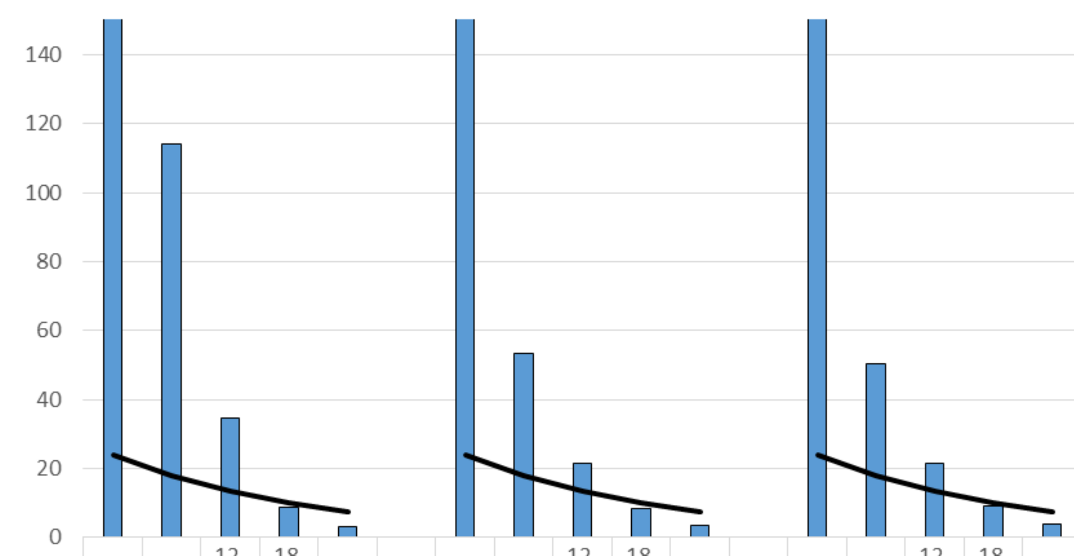
This analysis has considered the effects of a changing climate. Though this alternative would result in a landscape more resilient to climate change than the No Action Alternative, climatic models for the southwestern U.S. predict continued warming, greater variability in precipitation, and increased drought. These climatic changes would likely contribute to some level of tree mortality; however, considerably less than the No Action Alternative. A changing climate may lead to large shifts and contractions in the range of dominant trees throughout much of the region (Kane et al, 2014).

Structure

Uneven-aged Structure

It is desirable for uneven-aged forest structure to occur on a majority of acres. Under this alternative, there would be a change to forest structure (Figure 35) on the acres proposed for treatment, however large untreated areas would see little change to existing forest structure. This alternative would meet the Desired Condition for uneven-aged structure in the Forest Plans, however forest structure would more closely resemble NRV in treated stands. Modeling indicates that some stands would move towards more even-aged conditions in the dominant cover types proposed for treatment as a result of removal of trees from the smaller size classes and retention of trees in the larger size classes. However, as treatments are applied on the ground, the use of the large and old tree implementation plans, in accordance with an uneven-aged thinning strategy, would be able to produce uneven-aged conditions across much of the landscape. In treated stands, individual tree growth would increase and trees would move into larger size classes as a result of a reduction in individual tree competition. Naturally-occurring regeneration would provide additional vertical structure over time.

An additional, and potentially more substantial, benefit to forest structure would be a reduction in the possibility of an uncharacteristic wildfire or other substantial disturbance event, such as a beetle outbreak or long-term drought. Under this alternative, treated stands would be more resistant to uncharacteristic fire and insect outbreaks and more resilient to drought. The balance of size classes and uneven-aged structure would provide conditions favorable to restoration of a natural fire regime in the areas proposed for treatment. In areas of untreated stands, the potential for uncharacteristic fire or other substantial disturbances would persist as well as their associated effects on forest structure.



	2019					2029					2039				
	0-5"	5-12"	12-18"	18-24"	24"+	0-5"	5-12"	12-18"	18-24"	24"+	0-5"	5-12"	12-18"	18-24"	24"+
Alt 3	813	114	35	9	3	281	54	21	9	3	222	50	21	9	4
Idealized	24	18	14	10	8	24	18	14	10	8	24	18	14	10	8

Figure 35. Alternative 3 – Focused Alternative – Distribution of trees per acres across size classes across the analysis area

Density

Measure of density in this analysis include trees per acre, basal area and stand density index. On a portion of the project area prescribed fire and thinning would change the size class distribution of trees. Alternative 3 would meet the desired condition on a smaller portion of acres as compared to the Proposed Action. The overall tree density would decrease under this alternative, with 973 trees per acre in 2019, 368 in 2029 and 307 trees per acre in 2039. While the initial reduction in trees per acre would result from a combination of mechanical and prescribed fire activities, the reduction after 2029 can be attributed to the recurring prescribed fire over time. Prescribed fire could more likely be used to balance the size classes at the lower end of the VSS distribution and move the landscape toward the desired condition. For example, prescribed fires with higher severity effects (e.g., burning under hotter and/or dryer conditions) from 2029 to 2039 could be implemented to maintain the desired size class distribution at the lower end and better meet the desired condition.

Similar to the Proposed Action, the reduction in tree density would increase individual tree growth and reduce density dependent tree mortality. Understory grasses, forbs, herbs, and shrubs would increase in quantity in treated areas (Covington & Moore, 1994a).

Like many of the other indicator measures, the effects of the Focused Alternative on trees per acres would resemble those of the Proposed Action, only to a lesser degree. It is important to note that this is because fewer acres would be treated compared to the Proposed Action; however those acres that would be treated would still be treated at the same intensity as the Proposed Action.

The desired condition is to retain a basal area of between 30 and 90 ft^2 per acre across most habitat types outside of MSO PACs. While the Forest Plans provide a desired condition with a range of basal areas ranging from 20 to 180 ft^2 depending on cover type, for this analysis, at the project level, for ease of comparison of effects between alternatives, 90 ft^2 is the breakpoint for the resource measure across the analysis area For both mixed conifer and ponderosa pine cover types it is desired to maintain basal area at less than 90 ft^2 though exceptions exist to provide heterogeneity across the landscape as well as specific wildlife needs for dense and closed canopy forest conditions. For a more thorough analysis of the effects of this alternative within MSO and Northern goshawk habitat, consult the Wildlife Specialist Report (USDA 2019).

Under the Focused alternative, basal areas across the analysis area average would be reduced to 87 square feet per acre in 2029 and 89square feet per acre in 2039. While currently only 13 percent of stands meet the desired condition, by the year 2029 52 percent of stands would meet the desired condition and by 2039, 55 percent of stands would meet the desired condition. This would result in decreased inter-tree competition for resources such as water, light, growing space and nutrients in treated areas. Individual tree growth would increase and density dependent mortality would be dramatically reduced along with susceptibility to potential insect and disease outbreaks. These conditions would indicate a shift from the current larger and higher intensity fires that the forest would currently experience to cooler, higher frequency, lower severity surface fires (Cooper, 1960) (Swetnam, 1990) (Covington & Moore, 1994a) (Kolb, Wagner, & Covington, 1994) (Swetnam & Baisan, 1996) that persisted prior to European settlement.

While some effects such as increased diameter growth and reduced competition would be reduced only in treated stands, other effects, such as landscape level insect hazard and fire severity, may extend to untreated areas. The reductions in basal area would allow the treated areas to meet the desired conditions and purpose and need for fire-adapted, resilient, diverse, and sustainable forest ecosystems at the landscape and watershed scales.

While some watersheds would have their average basal areas reduced to within the desired condition as a result of proposed activities, some watersheds such as Rye Creek-Tonto Creek would experience considerable additional mortality as a result of prescribed fire between 2029 and 2039. This is a similar effect as with the Proposed Action and is a result of the intensity of the prescribed fire modeled, as well as the fact that most of the acres proposed for treatment in Alternative 2 were also proposed for treatment in the Focused Alternative. Prescribed fires with lower severity effects (e.g., burning under cooler and/or wetter conditions) from 2029 to 2039 could be implemented to maintain the desired basal area and continue to meet the desired condition in some watersheds.

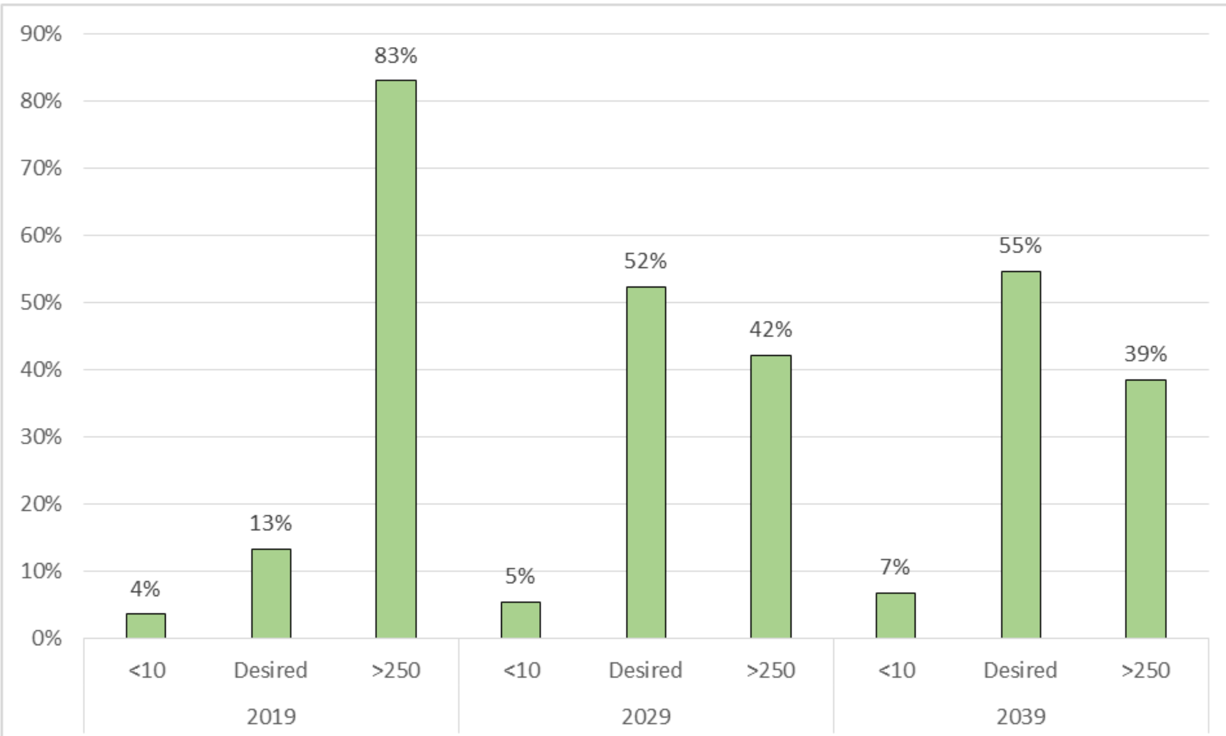


Figure 36. Alternative 3 – Focused Alternative – Percent of acres meeting desired condition for trees per acre across the analysis area

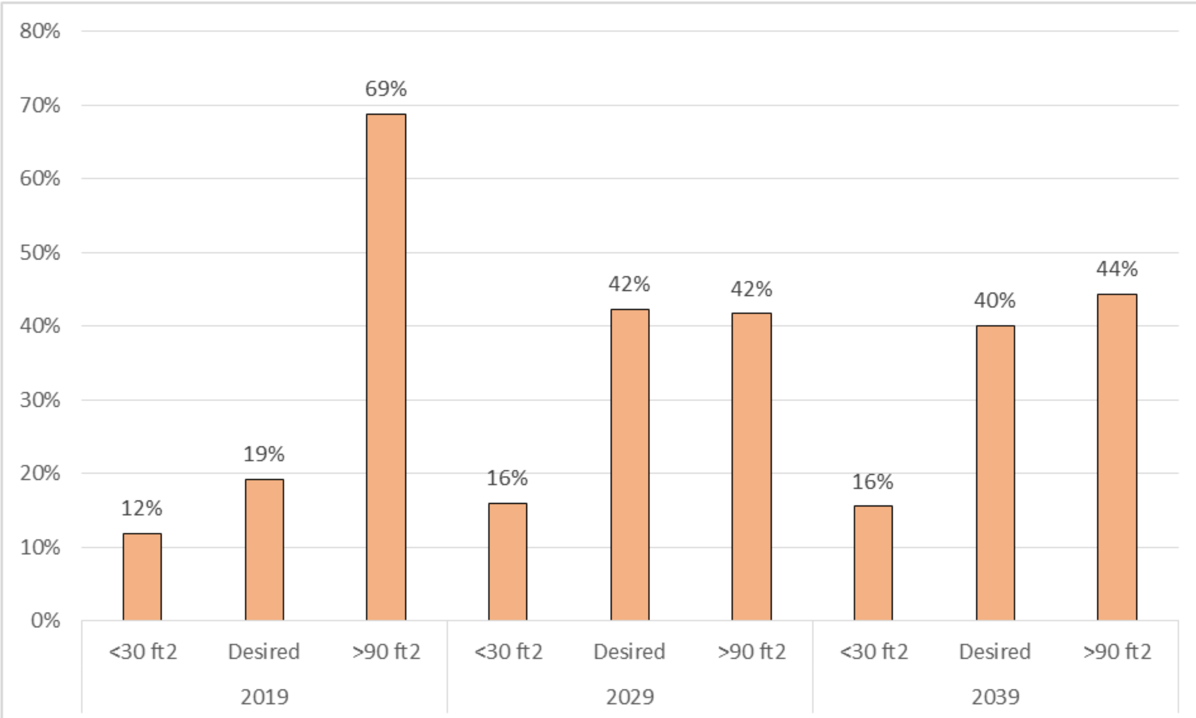


Figure 37. Alternative 3 – Focused Alternative – Percent of acres meeting desired condition for basal area across the analysis area

Stand Density Index (SDI) is a measure of relative stand density based on the number of trees per acre and the mean diameter (Long 1995). Percent SDImax expresses the actual density in a stand relative to a theoretical maximum density possible for trees of that diameter and species. SDI is a good indicator of how site resources are being used by taking both average tree size and trees per acre into account. SDImax represents an empirically-based estimate of the maximum combination of quadratic mean diameter and density which can exist for any stand of a particular forest type.

The desired condition for SDI is to be between 25 percent and 45 percent of SDIMax or between 112.5 and 202.5. Currently across the analysis area, SDI averages 296 or 66 percent of SDImax and is considered extremely high. As a result of Alternative 3, SDI would be reduced to 172 or 38 percent of SDIMax by 2029 and 170 or 38 percent of SDIMax by 2039. While currently 15 percent of the acres in the analysis area meet the desired condition, as a result of the Focused Alternative, 27 percent would meet the desired condition and 21 percent would in 2039.

SDI values between 25 percent and 45 percent of SDIMax are associated with maximum understory production and maximum individual tree diameter growth as overall stand growth is concentrated on fewer trees. Depending on the level of tree aggregation, little inter-tree competition would be occurring. Competition may still be occurring within dense tree groups regardless of stand level SDI values.

Over time with the Focused Alternative, stand densities should stabilize in treated areas as the reintroduction of fire returns natural disturbance processes to the landscape. This would result in reduced susceptibility to insect epidemics, particularly bark beetles as well as reduced density dependent mortality, increased individual tree diameter growth, and forage production over time and continued attainment of the desired condition.

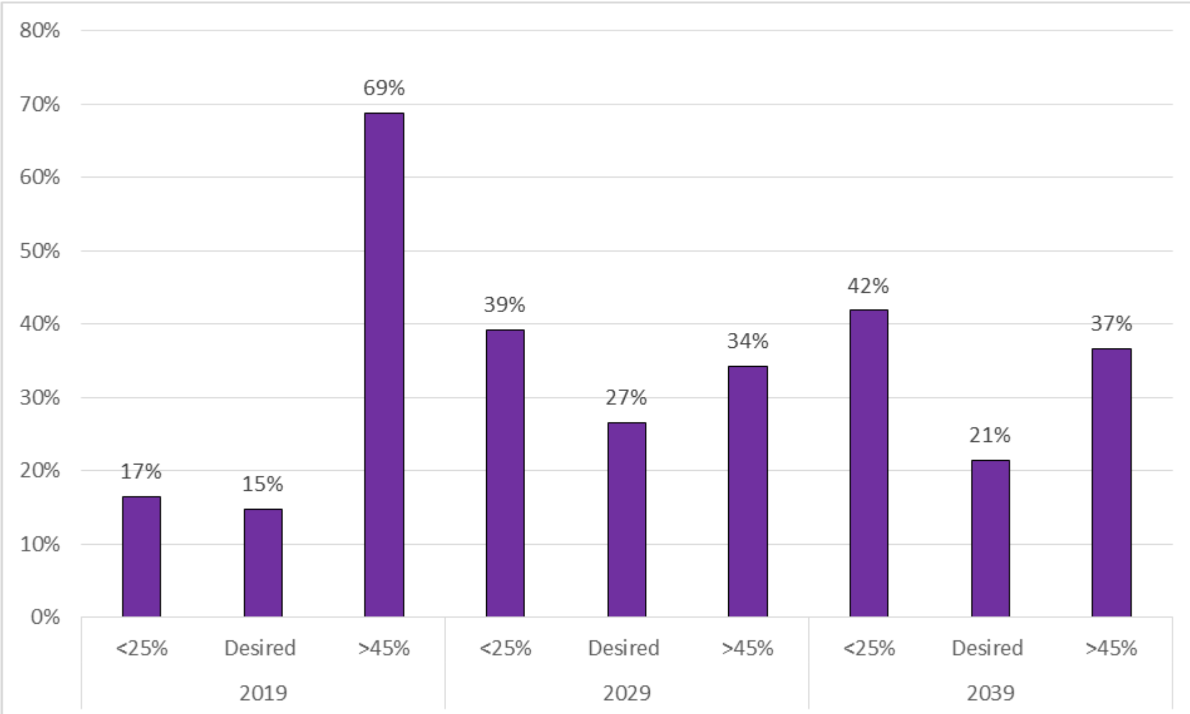


Figure 38. Alternative 3 – Focused Alternative – Percent of stands meeting the desired condition for stand density index

Large Tree and Old Tree Structure

Stands of post settlement trees where the quadratic mean diameter of the top 20 percent of trees is greater than 15 inches and the basal area of trees greater that 16 inches is more than 50 feet of basal area can be considered stands with a preponderance of large young trees (SPLYT stands). These stands occur outside of MSO PACs, MSO Recovery habitat and WUI and are being identified for their distinctive forest structure.

Currently, across all 5th HUC watersheds in the analysis area the number of acres meeting SPLYT criteria is 36,325 a QMD of the top 20 percent of trees being 19 inches. Under the focused alternative, this number would increase to 72,424 by 2039 with a QMD of the top 20 percent of trees being 22 inches. The number of acres meeting SPLYT criteria would increase as a result of the Focused Alternative, but at a slower rate than the Proposed Action. With design features in place during implementation, large trees meeting the large and old growth tree implementation plan criteria would be retained, resulting in more large trees being left at the expense of smaller tree sizes. This would allow the proportion of stands meeting desired condition for large trees to actually increase over time. During implementation, some large trees would be cut in accordance with the large and old growth tree implementation plans in order to meet the desired condition. In treated areas, remaining larger trees would be less susceptible to mortality from drought, insects, disease, and wildlife. (Das et al. 2011, Ritchie et al 2008), whereas in untreated areas, susceptibility to these disturbance agents would continue to increase. This slower rate of SPLYT acre recruitment does not take into account the application of the Large Tree Implementation Plan that would effectively increase the number of SPLYT across the landscape at the expense of trees in the smaller size classes.

This alternative would result in a lower risk of mortality in the stands that were treated, especially for larger trees, because of a decreasing risk of infection from pests or disease (Fischer et al, 2010), high-severity or uncharacteristic wildfire (Coop et al, 2016) (Fiedler et al, 2010), and drought stress from competition (Erickson & Waring, 2014). A number of studies have found that lower forest density leaves large and old trees less susceptible to mortality as a result of these factors. Erickson and Waring (2014) concluded that, "treatments removing small, neighboring trees may be critical in maintaining old ponderosa in the landscape, particularly under future climate change and increasing drought frequency in the western USA." While this alternative may increase the amount of acres meeting SPLYT criteria as a slower rate than the No Action Alternative, the acres proposed for treatment would be far less likely to experience substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristic wildfire).

In untreated areas, the effects would be similar to the no action alternative and would result in a higher risk of mortality, especially for larger trees, because of an increasing risk of infection from pests or disease (Fischer et al, 2010), high-intensity or uncharacteristic wildfire (Coop et al, 2016) (Fiedler et al, 2010) or increased drought stress from competition (Erickson & Waring, 2014). While this alternative may increase, on untreated areas, the amount of SPLYT acreage based on model results, these results do not account for the likely substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristic wildfire), which would decrease the amount of old and large trees and SPLYT acreage in the analysis area.

Forests would have the ability to manage more acres of naturally occurring wildfires to benefit forest resources, mainly within watersheds that have a considerable portion proposed for treatment. In treated areas, forest structure, including openings, interspace, and groups and clumps of trees would allow for low to moderate fire severity that would maintain opening and have little potential effect on the vegetation resource except for trees in the smaller size classes.

Under this alternative, on untreated acres where wildfires are managed for resource benefit, they may have the effect of reducing basal area and SDI by killing small trees or groups of small and/or intermediate aged trees. These fires could also result in mortality of some large and old trees. Based on those areas of recent wildfires that were managed for resource benefits, this effect would be very limited across the landscape in untreated areas. For a more thorough description of post treatment fire behavior consult the Fire Ecology Specialist Report in the project record.

Forest Process

Insects

Under this alternative, the proportion of acreage with a high hazard rating for bark beetles would decrease from 74 percent to 39 percent in 2029 and to 40 percent by 2039. The majority of acres that would remain with a high hazard rating are as a result of a lot of acres remaining untreated. While the proportion of acreage with a moderate rating would change only slightly, the proportion of acreage with a low hazard rating would increase considerably as the analysis areas approaches desired condition for this indicator. Stands with a low or moderate bark beetle rating, the desired condition, would increase from 26 percent in 2019 to 61 percent in 2039 and 60 percent by 2039

Stands with lower tree densities and basal area are more resilient to drought and beetle attacks. Bark beetle population dynamics suggests that homogenous, dense stands are highly susceptible to beetle outbreaks. The proposed action would create heterogeneous, open, uneven-aged stands that would dramatically reduce susceptibility and maintain that reduced susceptibility over time. Susceptibility to western pine beetle would decrease over time with mechanical treatment and reintroduction of low severity surface fire. Areas with the greatest likelihood of infestation from bark beetles are areas treated at a low intensity as to not considerably affect beetle hazard rating. Additionally, areas with large amounts of slash remaining post treatment are at risk for ips beetles. Some susceptibility to ips would continue to increase with activity most likely occurring in response to a drought or a snow or ice event that creates fresh pine debris.

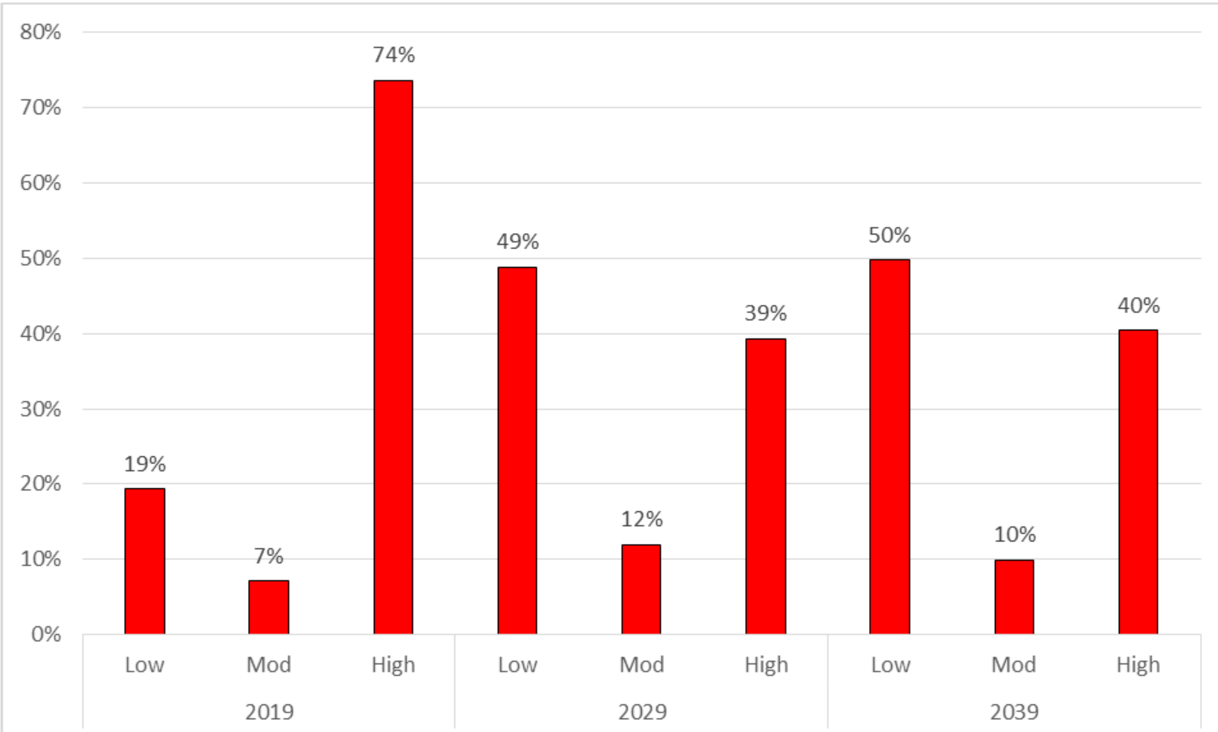


Figure 39. Alternative 3 – Focused Alternative – Distribution of Bark Beetle Hazard Rating classes across the analysis area

Disease

Currently, across the analysis area, approximately 75 percent of the area is not infected or has a low infection level, 22 percent has a moderate severity rating and 4 percent has a high severity rating. Initially, as a result of the Focused Alternative, stands with a high severity rating would drop to 2 percent and stands with a Low or None rating would increase to 84 percent by the year 2029. The effects of the mechanical treatment and prescribed fire would diminish over time as acres with a severe rating increase to 4 percent and acres with a Low or None rating decrease to 66 percent by 2039, as a result of infection intensification and spread occurring even after treatment over some of the analysis area. With the exception of the change in severe infection, this result would be similar to the effects from the Proposed Action.

In areas not treated under this alternative, dwarf mistletoe infections may intensify and spread to surrounding trees, reducing the growth, vigor, and longevity of ponderosa pine (Conklin and Fairweather 2010). However, across the analysis area, growth, longevity, and vigor of ponderosa pine trees would be increased, approaching the desired condition. This is an improvement in dwarf mistletoe severity rating over the No Action Alternative by the year 2039, as the reduction in severely infected stands substantially affects forest health, growth, vigor, and resilience. In the untreated and severely infected stands, mistletoe infection would intensify and spread over time. Dwarf mistletoe infections would not be reduced in these areas and may intensify in infected trees and the surrounding trees, reducing the growth, vigor, and longevity of ponderosa pine. These stands would further depart from the desired condition over time as infected stands intensify their infections and infect adjacent areas (Conklin and Fairweather 2010).

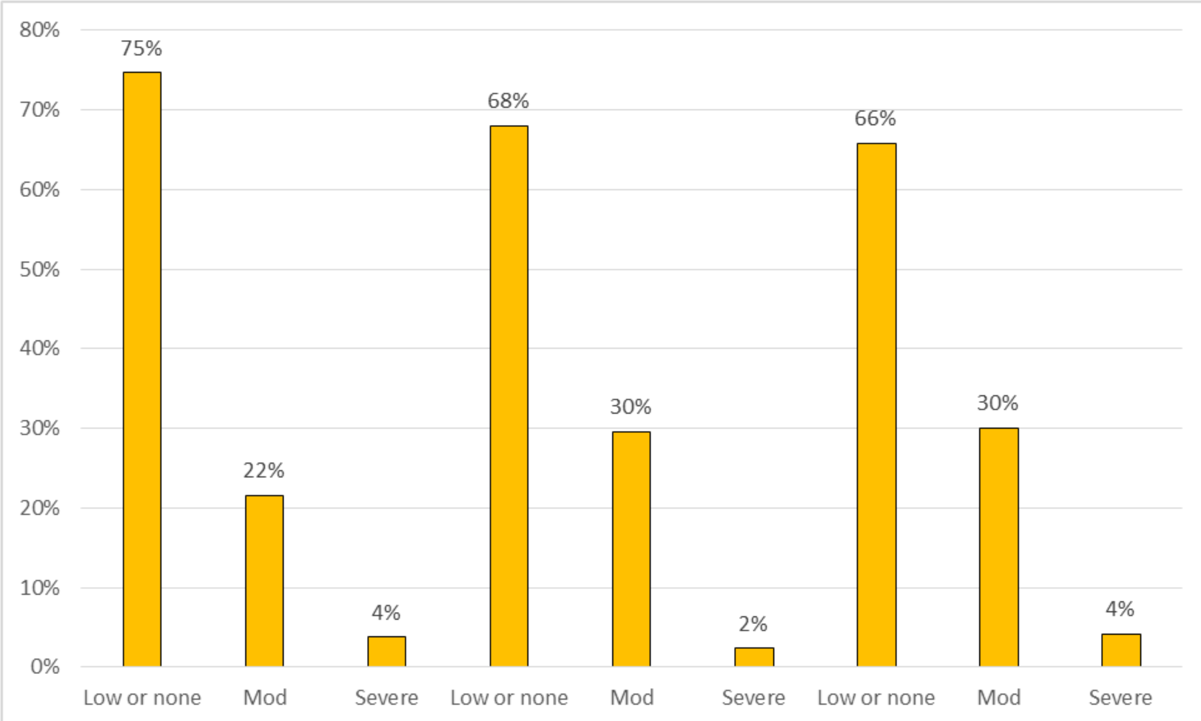


Figure 40. Alternative 3 – Focused Alternative – dwarf mistletoe severity rating classes across the analysis area

Fire Adaptation

For a more thorough discussion of this alternative in terms of fire adaptation, consult the Fire Ecology Specialist Report (USDA 2019). In general, this alternative does support the purpose and need to develop or return to a forest ecosystem that is fire-adapted, resilient, diverse, and sustainable. In areas where treated, this alternative would support the shift away from larger high severity fires to conditions that are more likely to support increasingly frequent, low severity surface fires (Cooper 1960) (Swetnam 1990) (Covington and Moore, 1994a) (Kolb et al 1994) (Swetnam and Baisan, 1996). Over time this alternative would create conditions that resemble the NRV of plants and animals living in western ponderosa pine and dry mixed conifer forests (Covington and Moore 1994a, Reynolds et al 2013). As a result, in areas where treated, this alternative would reduce the susceptibility to uncharacteristically severe fires and other disturbance agents, such as bark beetles and disease, over time. Many areas not treated would remain susceptible to uncharacteristically severe fires and increase in vulnerability to other disturbance agents, such as bark beetles and disease, over time.

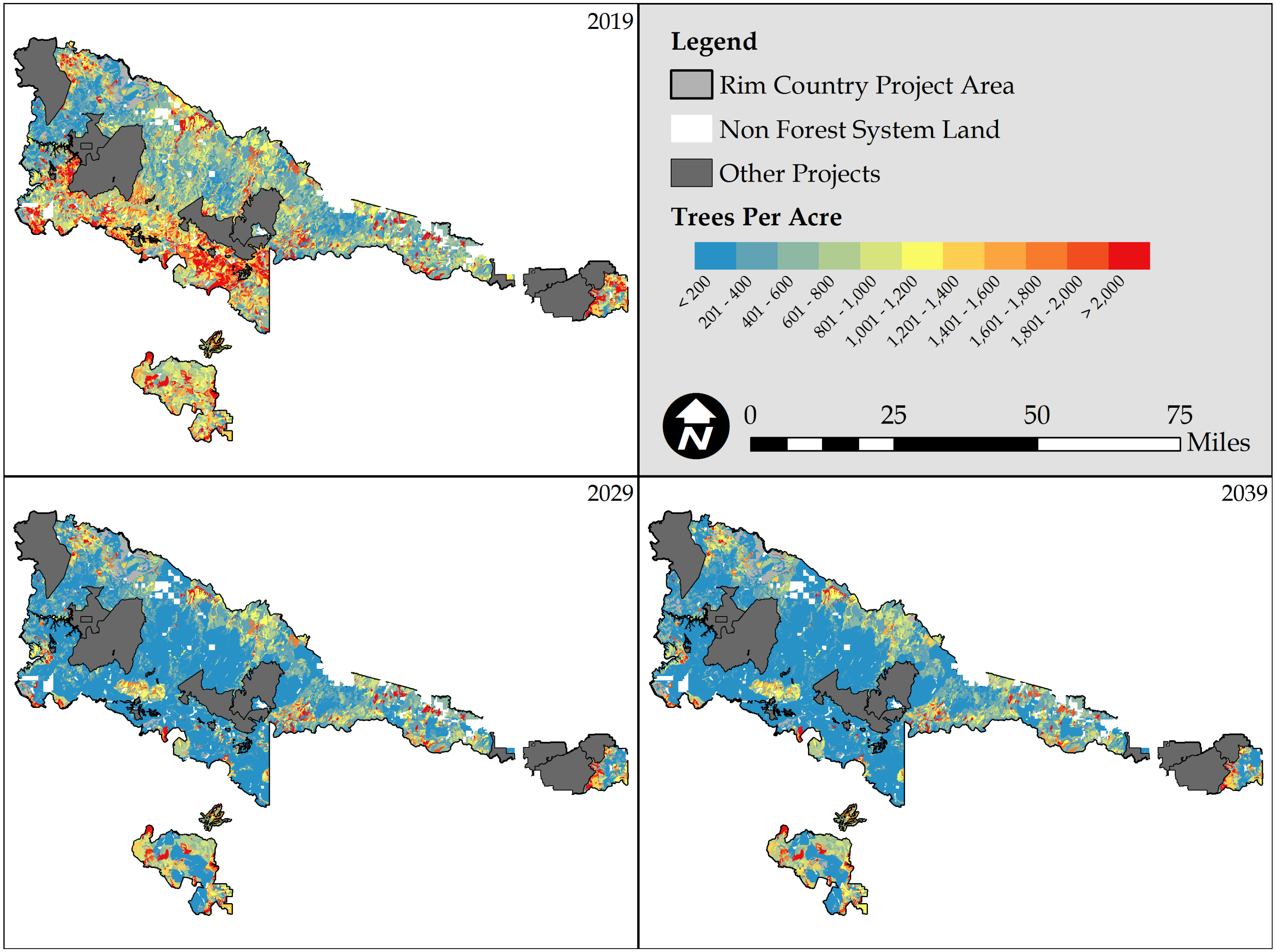


Figure 41. Alternative 3 – trees per acre

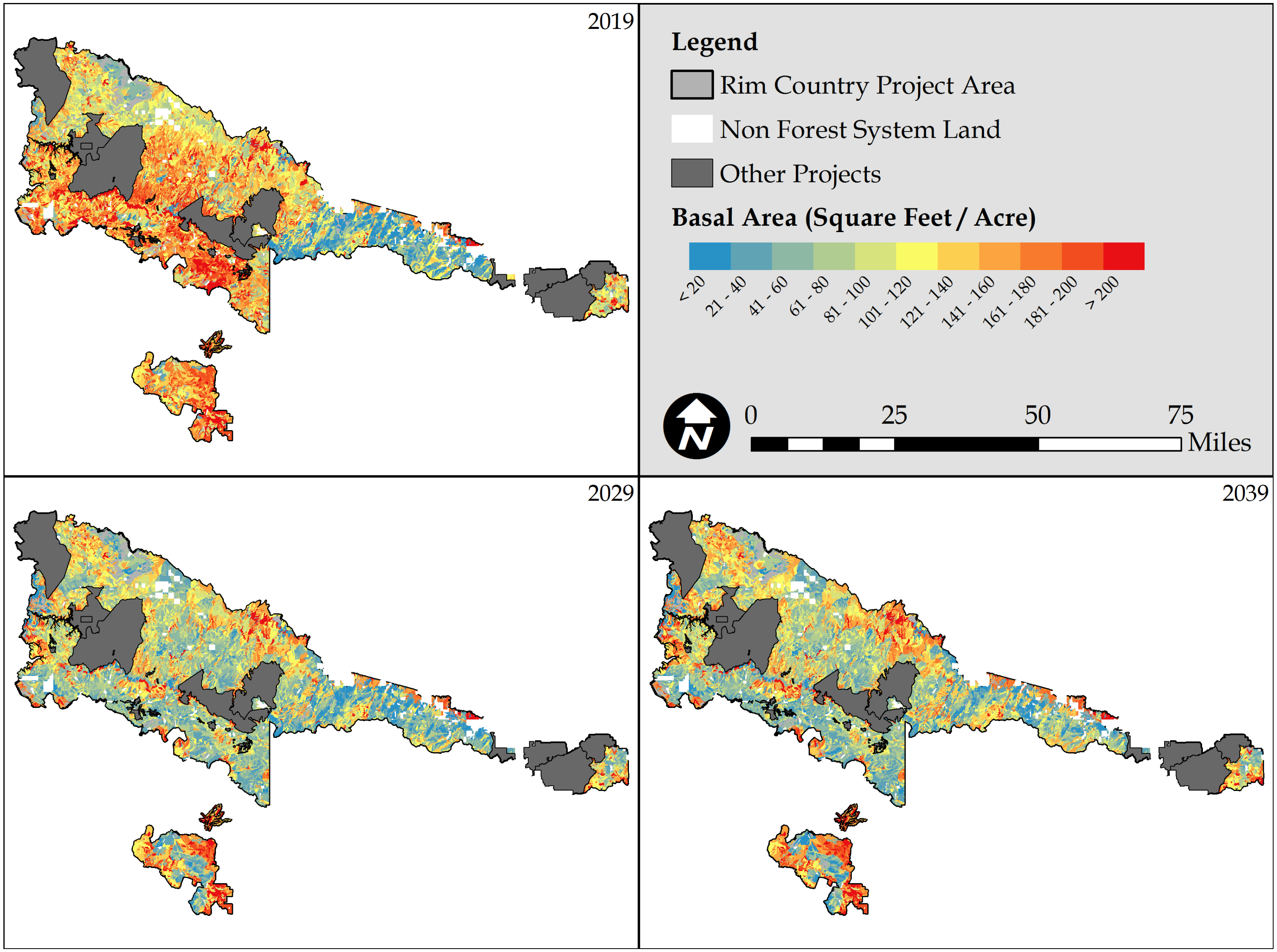


Figure 42. Alternative 3 – basal area

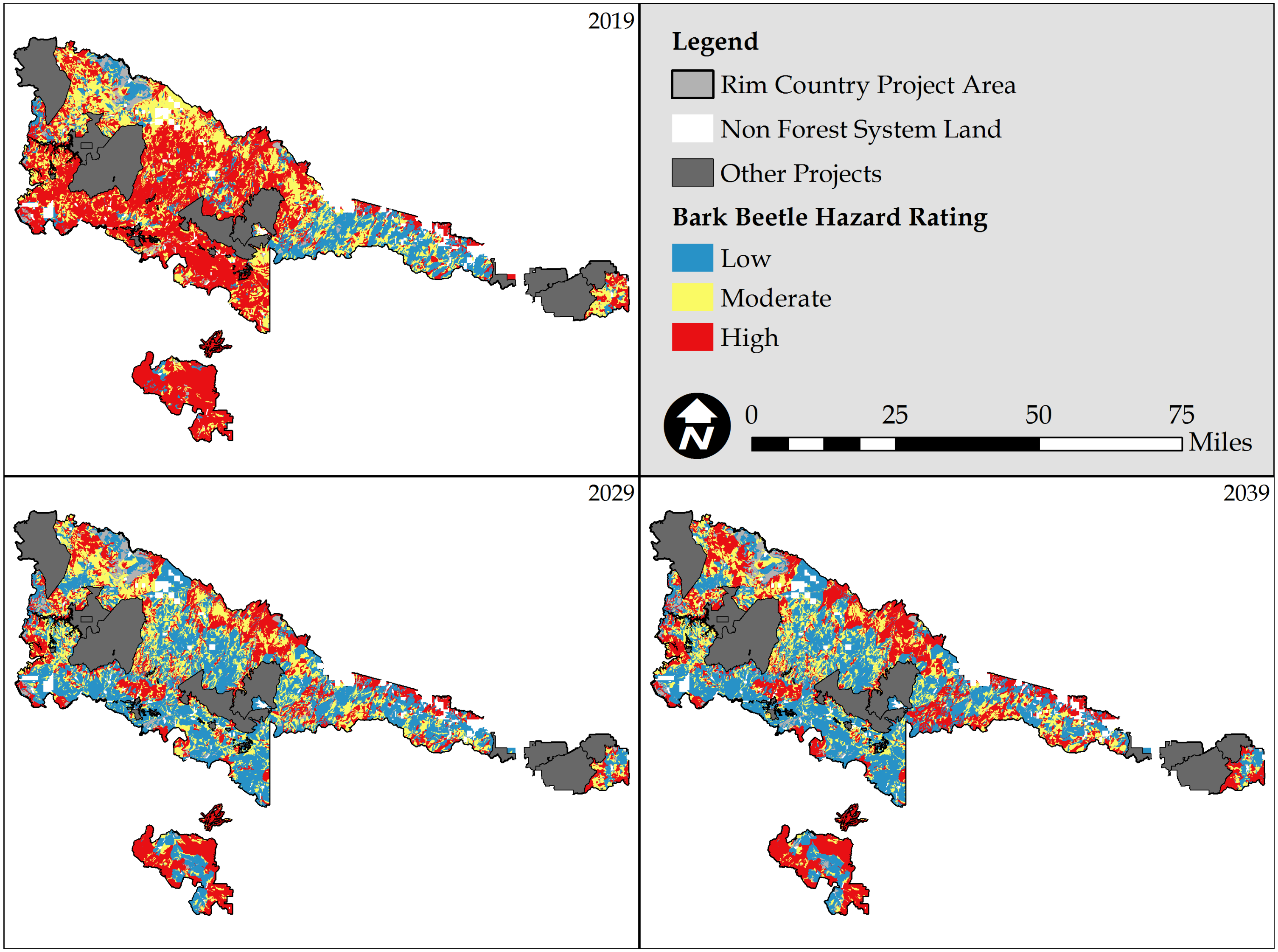


Figure 43. Alternative 3 – bark beetle hazard rating

Table 24. Summarized effects of the Alternatives

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Forest Structure - General	Stand structure would continue to not meet the desired conditions as smaller trees are overrepresented. This trend would be expected to continue, leading to increased density dependent mortality, while basal area and stand density index (SDI) would continue to increase. The number of trees per acre and basal area and SDI would move further away from the natural range of variation (NRV) and the desired conditions. This trend would be expected to continue. Insect hazard rating and severity of dwarf mistletoe infections would continue to increase.	Stand structure would move toward desired conditions as trees would be well distributed across size classes. The number of trees per acre, basal area, and SDI would decrease considerably, trending toward desired conditions within NRV as a result of thinning and prescribed fire activities. Insect hazard rating and dwarf mistletoe severity would be reduced in treated areas, thus moving toward the desired conditions.	In general, the effects would be similar to the effects of Alternative 2, with a muted effect due to the fewer number of acres treated, and would only be observed in the stands treated. The number of trees per acre, basal area, and SDI would decrease considerably, trending toward desired conditions within NRV as a result of thinning and prescribed fire activities. Insect hazard rating and dwarf mistletoe severity would be reduced in treated areas, thus moving toward the desired conditions.
Forest Structure - Pattern	Stands would continue to remain in a closed condition, lacking groups and clumps of trees or randomly spaced trees. Grasses forbs and shrubs would continue to be underrepresented. Forest structure would continue to be departed from historic conditions.	This alternative would generally meet the desired condition. The majority of stands would be in an open condition. Forest arrangement would be in individual trees, small clumps, and groups of trees or randomly spaced trees that are similar to historic patterns and are as a result of the proposed action Most forest stands in uneven-aged condition to meet forest resilience and sustainability goals while maintaining wildlife habitat.	This alternative would generally meet the desired condition on the acres that were treated, however the acres that were not treated would resemble the conditions described in the no action alternative. Forest arrangement would resemble historic forest structure in some places, while many other areas would not meet the desired condition for forest pattern and structure.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Forest Structure – Trees per Acre	Total trees per acre continues to remain above the desired condition. The percentage of acreage in the project within desired condition moves up from 13 percent in 2019 to 15 percent in 2039 as a result of density-dependent mortality. Tree distribution does not approximate the idealized distribution with too many trees in the smaller size classes. By 2039 there would be 621, 121, 39, 12, and 4 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.	The percentage of acreage within desired condition for trees per acre increases dramatically from 13 percent in 2019 to 84 percent in 2049. The distribution of trees across size classes approximates the idealized distribution by 2039 better than any of the other alternatives. By 2039 there would be 48, 18, 14, 8, and 4 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.	Trees per acre: The percentage of acreage within desired condition for trees per acre increases from 13 percent in 2019 to 55 percent in 2039. Tree distribution does not approximate the idealized distribution with too many trees in the smaller size classes. By 2039 there would be 222, 50, 21, 9, and 4 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.
Forest Structure – Basal Area	Average basal area would continue to increase across the project area from 129 square feet per acre in 2019 to 150 square feet per acre in 2039. The percentage of acres that would meet desired condition decreases from 19 percent in 2019 to 12 percent by 2039.	Average basal area would decrease across the project area from 129 in 2019 to 65 in 2029 and 62 in 2039. The percentage of acres that meet desired condition would increase from 19 percent in 2019 to 58 percent in 2029 and then to 56 percent in 2039.	Average basal area would decrease across the project area from 129 in 2019 to 87 in 2029 and 89 in 2039. The percentage of acres that meet desired condition for basal area would increase from 19 percent in 2019 to 42 percent in 2029 and then to 40 percent in 2039.
Forest Structure – Stand Density Index	Average stand density index would continue to increase across the project area from 296 in 2019 to 324 in 2039. The percentage of acres that would meet desired condition decreases from 15 percent in 2019 to 11% in 2039.	Average stand density index would decrease across the project area from 296 in 2019 to 116 in 2029 and 103 in 2039. The percentage of acres that meet desired condition would increase from 15 percent in 2019 to 27 percent in 2029 and then 21 percent in 2039.	Average stand density index would decrease across the project area from 296 in 2019 to 172 in 2029 and 170 in 2039. The percentage of acres that meet desired condition would increase from 15 percent in 2019 to 27 percent in 2029 and then to 21 percent in 2039.
Forest Insects	The proportion of acreage that would meet the desired condition for bark beetle hazard decreases from 26 percent in 2019 to 19 percent in 2039 as a result of increased stocking and lack of disturbance over time.	The proportion of acreage that would meet the desired condition for bark beetle hazard would increase from 26 percent in 2019 to 92 percent in 2039.	The proportion of acreage that meet the desired condition for bark beetle hazard would increase from 26 percent in 2019 to 60 percent in 2039.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Forest Disease	The proportion of acreage with a severe dwarf mistletoe rating would increase from 4 percent in 2019 to 9 percent in 2039. The proportion of acreage that meets the desired condition decreases from 96 percent in 2019 to 91 percent in 2039.	The proportion of acreage with a severe dwarf mistletoe rating would decrease from 4 percent in 2019 to 3 percent in 2039. The proportion of acreage that meets the desired condition would increase from 96 percent in 2019 to 97 percent in 2039.	The proportion of acreage with a severe dwarf mistletoe rating remains essentially unchanged from 4 percent in 2019 to 4 percent in 2039. The proportion of acreage that meets the desired condition also remains unchanged from 96 percent in 2019 and 2039.

Cumulative Effects

For the cumulative effects analysis, the spatial context being considered is the 1,238,658 acre project area. Cumulative effects are discussed in terms of vegetation management and prescribed fire activities as well as the effects of wildfire that have occurred since as early as 1990 and as changes in the existing condition due to present and foreseeable activities, including the effects of the alternative being discussed. The baseline year used for this analysis is the year 2019 as the existing condition. In this analysis, all past activities and events are included in the existing condition description. In the effects discussion, post treatment refers to the time the final activity is accomplished (year 2019), "short-term" effects refers to effects over the 10-year period from the time the final activity was accomplished (year 2029). Beyond 20-years we will be considering effects as "long-term" (year 2049). All alternatives are compared across forest boundaries (Apache-Sitgreaves, Coconino and Tonto Forests combined).

Vegetation Management Activities and Prescribed Fire

Table 25 lists approximate acres of the various vegetation management activities, prescribed burning, and other activities that have occurred within the project area as part of vegetation management projects from as early as 1990 to 2017. This includes 469,036 acres of mechanical vegetation management activities that mainly consisted of tree thinning involving heavy equipment and 567,935 acres of prescribed fire. Additionally, 122,264 acres of other activities have occurred in the project areas including 4,645 acres of wildlife habitat improvement, 7,694 acres of range vegetation control, 39,708 acres of range vegetation manipulation, 17,475 acres of tree encroachment control, 45,561 acres of tree release and weed, 15 acres of fuel compaction, 571 acres of fuels chipping, 2,749 acres of range forage improvement, 96 acres of special products removal, 203 acres of insect control and prevention, 1,256 acres of fuel breaks, 1,238 acres of planting, 616 acres of cultural site protection, 321 acres of scarification and seeding of landings and 116 acres of pruning. Table 56 includes projects such as right of way, habitat improvement, reforestation, spring/meadow and other activities within the cumulative effects area. Table 27 includes reasonably foreseeable projects and activities with approximate acres of within the cumulative effects area. For additional information on the actions considered in this cumulative effects analysis, see Chapter 3 of this EIS.

Table 25. Approximate acres of vegetation management activities and prescribed fire within and adjacent to the cumulative effects area 1990-2017

Project Name	Year	Mechanical	Prescribed Fire	Other Activities*	Forest
Mullen Saw timber and Whitcom Multiproduct Offerings	1990	0	130	685	Apache-Sitgreaves
Jersey Horse Timber Sale	1991	1,452	351	0	Apache-Sitgreaves
Amended Elk Timber Sale	1993	834	466	0	Apache-Sitgreaves
Brookbank Multi-Product Timber Sale	1994	5,624	4,981	0	Apache-Sitgreaves
Cottonwood Wash Ecosystem Management Area	1995	516	2,447	0	Apache-Sitgreaves
Blue Ridge-Morgan	1997	14,471	14,552	0	Apache-Sitgreaves
Gentry	1997	451	191	0	Apache-Sitgreaves

Project Name	Year	Mechanical	Prescribed Fire	Other Activities*	Forest
Sundown Ecosystem Management Area	1997	2,075	24	7,023	Apache-Sitgreaves
Wiggins Analysis Area	1998	0	4,224	0	Apache-Sitgreaves
Show Low South (#22297)	1999	0	2,696	0	Apache-Sitgreaves
Larson Rx Burn	2001	0	3,015	0	Apache-Sitgreaves
Treatment of Dead Trees in the Rodeo-Chediski Fire (#20740)	2002	5,730	1,880	15	Apache-Sitgreaves
Heber-Overgaard WUI	2003	5,089	686	1,208	Apache-Sitgreaves
Hidden Lake Rx Burn	2003	0	2,828	0	Apache-Sitgreaves
Camp Tatiyee / Camp Grace Fuel Reduction	2004	0	172	0	Apache-Sitgreaves
Country Club Escape Route	2004	524	1,848	915	Apache-Sitgreaves
High Value Ponderosa Pine Tree Protection	2004	985	826	203	Apache-Sitgreaves
Rodeo-Chediski Fire Salvage	2004	25,913	626	1,667	Apache-Sitgreaves
Forest Lakes WUI Treatment	2005	1,691	1,645	0	Apache-Sitgreaves
Rim Top Rx Burn (formerly Woods Canyon Fuel Treatment)	2005	0	665	0	Apache-Sitgreaves
Show Low South (#4456)	2005	10	585	0	Apache-Sitgreaves
Dye Thinning	2006	247	0	0	Apache-Sitgreaves
Hilltop WUI	2006	1,534	45	616	Apache-Sitgreaves
Bruno Thinning and Slash	2009	0	70	0	Apache-Sitgreaves
Whitcom WUI	2009	925	0	0	Apache-Sitgreaves
Hilltop II Fuels Reduction	2011	0	799	616	Apache-Sitgreaves
Little Springs WUI	2003	4,376	4,227	2,500	Apache-Sitgreaves
Nagel	2005	19,611	18,231	2,802	Apache-Sitgreaves
Los Burros	2006	30,237	13,059	29	Apache-Sitgreaves
Nutrioso WUI	2006	19,476	9,870	1,254	Apache-Sitgreaves
Show Low South (#29987)	2011	3,372	0	0	Apache-Sitgreaves

Project Name	Year	Mechanical	Prescribed Fire	Other Activities*	Forest
Rodeo-Chediski Fire Rx Burn	2012	0	9,506	14,832	Apache-Sitgreaves
Timber Mesa/Vernon WUI	2012	18,781	39,760	20,441	Apache-Sitgreaves
Rim Lakes Forest Restoration	2013	12,483	1,335	6,447	Apache-Sitgreaves
Larson Forest Restoration	2015	1,867	0	2,516	Apache-Sitgreaves
Upper Rocky Arroyo Restoration	2016	696	5,411	3,960	Apache-Sitgreaves
Section 31 Fuels Reduction	2017	44	0	0	Apache-Sitgreaves
Pocket Baker	2000	0	5,450	0	Coconino
Blue Ridge Urban Interface	2001	416	6,225	2,325	Coconino
IMAX	2002	0	6,008	0	Coconino
Pack Rat Salvage	2004	0	0	0	Coconino
Bald Mesa Fuels Reduction	2005	2,485	5,150	0	Coconino
APS Blue Ridge 69kV Transmission Line	2005	0	1,600	0	Coconino
Good/Tule	2006	1,389	2,025	0	Coconino
Post-Tornado Resource Protection and Recovery	2011	765	0	0	Coconino
Lake Mary Road ROW Clearing (ADOT)	2016	788	0	0	Coconino
Lake Mary Meadows Two Fuel Reduction	2005	117	10,223	803	Coconino
East Clear Creek Watershed Health Improvement	2006	40,020	38,470	40,000	Coconino
Victorine 10K Area Analysis	2006	9,015	29,585	0	Coconino
Upper Beaver Creek Watershed Fuel Reduction	2010	20,608	64,000	0	Coconino
Blue Ridge Community Fire Risk Reduction	2012	0	45,000	0	Coconino
Clints Well Forest Restoration	2013	11	6,639	0	Coconino
Hutch Mountain Communication Site	2017	1	0	0	Coconino
Ridge Analysis Area	1994	33,311	0	1,094	Tonto
Lion Analysis Area	2001	5,664	6,900	664	Tonto
Verde WUI	2004	10,648	48,500	5,000	Tonto
Parallel Prescribed Burn	2014	0	4,759	0	Tonto
Pine-Strawberry WUI	2006	41,086	19,868	200	Tonto
Chamberlain Analysis Area	2008	9,044	19,000	1,675	Tonto
Christopher/Hunter WUI	2009	10,763	19,000	939	Tonto
Cherry Prescribed Burn	2012	0	6,582	0	Tonto
Myrtle WUI	2012	103,891	75,800	1,835	Tonto

Project Name	Year	Mechanical	Prescribed Fire	Other Activities*	Forest
Grand Total		**469,036**	**567,935**	**122,264**	

*Other activities include but not limited to fuels chipping, range forage improvement or manipulation, range vegetation control, wildlife habitat improvement, tree encroachment control, tree release, fuels compaction, special products removal, insect control and prevention planting, fuel break creation, cultural site protection, scarification and seeding, pruning,

Table 26. Right of way, habitat improvement, reforestation, spring/meadow and other activities within the cumulative effects area

Project Name	Year	Mechanical	Prescribed Fire	Other Activities*	Forest
Right-of-Way (ROW) Projects with Herbicide Use					
Noxious Weeds and Hazardous Vegetation on State Highway ROWs	2004	25	0	11,005	Tonto
Grand Total for ROW Projects		25	0	11,005	
Wildlife Habitat Improvement, Grassland Restoration Projects/Allotment Projects					
Park Day Allotment	1994	2,193	0	701	Apache-Sitgreaves
Clear Creek Allotment	2000	2,397	0	3,237	Apache-Sitgreaves
Wallace Allotment	Unknown	0	0	1,747	Apache-Sitgreaves
Railroad Allotment (Formerly Carlisle Complex Vegetation Treatments)	2007	2,873	0	561	Apache-Sitgreaves
Apache Maid Grassland Restoration	2004	54,528	6,770	0	Coconino
Bar T Bar/Anderson Springs Allotment	2005	1,304	132,938	41,351	Coconino
Grand Total for Habitat and Grassland Projects		63,295	139,708	47,597	
Reforestation/Planting Projects					
Bison Reforestation	2003	356	312	583	Apache-Sitgreaves
Clay Springs Reforestation	2004	0	0	338	Apache-Sitgreaves
Jacques Marsh Elk Proof Fence & Riparian Planting	2006	0	73	0	Apache-Sitgreaves
Pierce Reforestation	2009	0	0	406	Apache-Sitgreaves
Rodeo-Chediski Riparian Planting	2010	0	0	1	Apache-Sitgreaves
Rodeo-Chediski Reforestation (#18675)	2007	0	150	1,056	Apache-Sitgreaves
Conifer Weeding for Aspen Enclosure	Unknown	65	0	0	Coconino

Project Name	Year	Mechanical	Prescribed Fire	Other Activities*	Forest
Grand Total for Reforestation Projects		421	535	2,384	
Spring and Meadow Restoration Projects					
Bill Dick, Foster, and Jones Springs Enhancement	2013	0	0	0	Coconino
Long Valley Work Center Meadow Restoration	2018	0	0	16	Coconino
Grand Total for Spring and Meadow Projects		0	0	16	
Other Projects					
ASNF - No NEPA docs found - various activities reported in FACTS but not tied to other named projects	Unknown	42,763	74,202	16,656	Apache-Sitgreaves
COF - No NEPA docs found - various activities reported in FACTS but not tied to other named projects	Unknown	16,049	15,175	4,695	Coconino
TNF - No NEPA docs found - various activities reported in FACTS but not tied to other named projects	Unknown	15,565	26,386	43,711	Tonto
Grapevine Interconnect (Grapevine Canyon Wind Project)	2012	0	0	0	Coconino
APS Line Maintenance	Unknown	87	0	0	Coconino
Sixteen Rock Pits and Additional Reclamation	2017	0	0	0	Coconino
Glen Canyon-Pinnacle Peak 345kV Transmission Line Vegetation Management	2014	0	0	0	Coconino
Noxious Weed Treatment Projects	2005	61,015	1,008	2,032	Tonto
Grand Total for Other Projects		135,479	116,771	67,094	
Grand Total		**199,220**	**257,014**	**128,096**	

*Other activities include, but not limited to pesticide control of invasives, control of range vegetation, control of tree encroachment, range cover manipulation, control of understory vegetation, wildlife habitat improvement, planting, animal damage control, tree release, site preparation, and biocontrol of invasives.

Table 27. Approximate acres of reasonably foreseeable activities within the cumulative effects area

Project Name	Mechanical	Prescribed Fire	Other Activities*	Forest
Rodeo-Chediski Mastication	301	301	0	Apache-Sitgreaves
Heber-Overgaard Insect and Disease Farm Bill CE	0	0	0	Apache-Sitgreaves
Heber Allotment	0	0	39,000	Apache-Sitgreaves
Pierce Wash Allotment-Section 18 Analysis of Vegetation Treatments	0	0	0	Apache-Sitgreaves
AGFD Fairchild Draw Elk Exclosure	0	0	0	Apache-Sitgreaves
Four Springs Trail Realignment	0	0	0	Apache-Sitgreaves
Heber-Overgaard Non-motorized Trail System	0	0	0	Apache-Sitgreaves
Navopache Electric Cooperative Trunk Line Addition	0	0	0	Apache-Sitgreaves
APS-Herbicide Use within Authorized Power Line ROWs on NFS Lands in AZ	0	0	2,136	Apache-Sitgreaves, Coconino, and Tonto
SRP-Herbicide Use within Authorized Power Line ROWs on NFS Lands in AZ	0	0	7,469	Apache-Sitgreaves, and Tonto
Cragin WPP	41,046	63,656	0	Coconino
Mogollon Rim Spring Restoration Project	0	0	5	Coconino
WAPA Glen Canyon-Rogers 230/345kV Integrated Vegetation Management	13,338	0	0	Coconino, and Tonto
Flying V&H Prescribed Fire	1,798	59,124	0	Tonto
Haigler Fuels Analysis	43,435	43,435	0	Tonto
Flying V and Flying H Allotment	10,875	0	0	Tonto
Hardscrabble Allotment Juniper Clearing	100	0	0	Tonto
New Delph Tank & Bear Tank Maintenance	0	0	0	Tonto
Pleasant Valley Northwest Grazing Allotments	0	0	0	Tonto
Red Lake Tanks	0	0	1	Tonto
Emory Oak Restoration	0	0	0	Tonto
Cragin-Payson Water Pipeline and Treatment Plant	350	0	350	Tonto
Grand Total	**111,243**	**166,516**	**48,961**	

Other activities include, but not limited to pesticide control of invasives, control of range vegetation, control of tree encroachment, range cover manipulation, control of understory vegetation, wildlife habitat improvement, planting, animal damage control, tree release, site preparation, and biocontrol of invasives,

Fire

Wildfires from 1943 to 2017 (Table 28) have burned on approximately 509,447 acres in or adjacent to the project area. Of these acres, it is estimated that the overall average fire severity to the vegetation was 20 percent high severity, 30 percent mixed severity and 50 percent low severity. There is wide variability among these percentages from fire to fire. For more information on the history of wildfires in the project area consult the Fire Ecology Specialist Report (USDA 2019).

Many of the wildfires that burned within the project area in the last 10 years were managed primarily for resource objectives instead of primarily for suppression, and they produced primarily low-severity fire effects. The vast majority of the mechanical thinning projects in the area have decreased the potential for active crown fire and crown fire initiation on acres thinned (469,036 acres from Table 25 and 199,220 from Table 26), and the potential for crown fire initiation, and high severity effects from surface fire (567,935 acres from Table 25 and 257,014 acres from Table 26). Past mechanical and prescribed fire treatments decreased the potential for crown fire by breaking up the vertical and horizontal continuity of canopy fuels.

Table 28. Wildfire acres within the project area 1943-2017

Year	Acres
1943-1989	40,994
1990-1999	37,369
2000-2009	262,531
2010-2017	168,583
Total	509,447

Timber Harvest

Past timber harvest practices influenced vegetation structure, pattern, and composition on the majority of the project area. From the late 1880s to the 1940s, logging that facilitated construction of the railroads was conducted by several lumber and timber companies in the areas of Holbrook to Flagstaff (Lightfoot 1978). By 1940, the railroads had removed much of the profitable lumber that could be easily accessed. In terms of vegetation structure, many of the largest and oldest tree sizes larger than 18” DBH were removed from many areas. Extensive regeneration with no large trees interspersed within the younger age classes occupied many of the harvested areas. The pattern on the landscape no longer resembled the Desired Condition outlined in the LRMP.

Past timber sales within the project area such as the Ridge Analysis Area (1994), and Brookbank Multi-product Timber Sale (1994), implemented prior to the Southwestern Region’s 1996 amendment of forest plans, targeted the harvest of medium and large diameter trees. In some cases, all trees over 12 inches in diameter were removed. This affected the presence of pre-settlement trees and old forest structure.

Today, at the landscape (project area) scale, pre-settlement trees are underrepresented in many areas. The focus on even-aged forest management continued until the mid-1990s, leaving the legacy of current forest conditions. Approximately 50 percent of the project area that received some type of regeneration or shelterwood harvest has regenerated. Many stands are even-aged, dense, and lack age class diversity. Today, the majority of acreage can be classified as young and mid-aged forests with a moderately closed to closed tree canopies.

Post 1996 Vegetation Treatments – Uneven-aged Management, Fire Hazard and Restoration

After the region-wide 1996 amendment, vegetation objectives included uneven-aged management () (Table 96 & 97). A review of the Forest Activity Tracking System (FACTS) timber database indicates that treatments designed to promote uneven-aged management began being recorded as early as 1991 on the Apache-Sitgreaves National Forest, in 1987 on the Coconino National Forest and 2001 on the Tonto National Forest. However, acres treated in this category continued to be minor in comparison to acres treated with even-aged methods until about 2005. These acres treated using uneven-aged silviculture systems should today, still be moving these acres towards their desired conditions. Acres still assigned to even-aged silviculture may, or may not, be moving towards desired conditions depending on whether or not the stands can/could be converted to an uneven-aged structure or have been successfully regenerating. Forests in the project area use even-aged management to some extent and the use of this silvicultural system is not precluded in current Forest Plans.

After 1996, the objective of most vegetation projects in the project area was to reduce the risk of high-severity fire, improve forest health (stand and tree resilience and vigor), and improve understory diversity. Retention of snags and managing for coarse woody debris was further enhanced with the 1996 amendment and made part of project requirements. The 1996 forest plan amendment also changed treatments in Gambel oak and the species was recognized for its role in managing for ecological diversity and high quality wildlife habitat.

With the exception of older projects that removed large, old trees and promoted even-aged management, most vegetation projects that contributed to the current condition within the project area occurred from 2000 to 2015. From 2000 to 2015, across the three Rim Country forests, examples of projects designed primarily to address the risk of undesirable fire behavior and effects in the project area include Heber-Overgaard WUI, Camp Tatiyee/Camp Grace Fuel Reduction, Forest Lakes WUI Treatment, Rim Top Rx Burn, Hilltop WUI, Whitcom WUI, Hilltop II Fuels Reduction, Little Springs WUI, Los Burros, Nutrioso WUI, Section 31 Fuels Reduction, Blue Ridge Urban Interface, Bald Mesa Fuels Reduction, Lake Mary Meadows Two Fuels Reduction, Upper Beaver Creek Watershed Fuels Reduction, Verde WUI, Pine Strawberry WUI, Christopher Hunter WUI, Cherry Prescribed Burn, Myrtle WUI and Haigler Fuels Analysis among others (Table 25). A variety of other projects have modified vegetation for other objectives such as grassland restoration, wildlife habitat improvement, maintaining rights of way, reforestation, noxious weeds as well as transportation system management (Table 26).

Natural Disturbances – Insect and Disease

Though many of the treatments identified in Table 23 and Table 26 were designed to reduce hazard of insects and diseases, these natural disturbance mechanisms are still present in these forests. Though prescribed fire, or any fire, increases the short-term risks to bark beetle infestations, mechanical and prescribed fire treatments have worked to reduce insect and disease risk by reducing density in terms of basal area, stand density index and trees per acre. Historic treatments as well as the treatments in the Rim Country analysis have worked together to reduce insect and disease risks. A comprehensive account of insect and disease activity occurring within the project area and cumulative effects area was provided by USDA Forest Health Protection (USDA 2016). Much of the information in that report comes from a combination of the Historical Reports for the three forests (Lynch et al. 2008, 2010, 2015), and aerial detection survey (ADS) data collected every year by Forest Health Protection (FHP) (USDA, Forest Service 2018).

For the Rim Country Project area, ADS indicates that activity of most agents has been relatively low for the past five years. In fact, much of the recent insect activity mapped in the project area occurred during the drought years from 2001-2005. Treatments listed in Table 25 and Table 26 have maintained these low levels and additional treatments in the Rim Country Project should improve the resilience of these forested systems. More details on the specific agents are discussed within their specific forest type below. We should also note that there are many insects and diseases which cause little damage or tree mortality (Furniss and Carolin 1977). Their effects are not considered extensive and will not be discussed in this cumulative effects analysis.

Generally speaking, current stands of ponderosa pine and mixed conifer are much denser with smaller average diameters than what was historically present prior to European settlement (Covington and Moore 1994). This change in stand structure appears to have favored certain insects and diseases, primarily bark beetles and Southwestern dwarf mistletoe Chojnacky 2000, Conklin 2000). Details on these are provided below. Root rot pathogens, although not specifically discussed by forest type, are present in all forest types. Root diseases can cause direct tree mortality and are often associated with secondary mortality such as bark beetle attacks (Fairweather et al 2013). Root diseases are often missed during surveys because their deleterious effects are gradual. Some management activities in the cumulative effects area have targeted trees with root rot and reduced its prevalence.

Bark Beetles

The primary two genera found in ponderosa pine, *Dendroctonus* spp. and *Ips,* spp. are capable of causing substantial tree mortality. Historical activity of mountain pine beetle in ponderosa pine in Arizona has been limited to areas on the North Rim of the Grand Canyon (Blackman 1931, Lynch et al. 2008). There are also multiple species of ips beetles found in the ponderosa pine forests of north central Arizona (Williams et al. 2008).

Historical reports indicate that both the size of bark beetle outbreaks and the beetle species involved in the outbreaks have shifted since the early part of the century. Most tree mortality in the ponderosa pine early in the 1900s was predominately attributed to beetles in the Dendroctonus genus. While periodic ips beetle attacks were also reported on all three forests, earlier ips beetle outbreaks were localized events, associated with slash management issues from forest management activities, windthrow, and drought. In contrast, the widespread, landscape-level tree mortality which occurred across the Rim Country Project area in the early 2000's was primarily attributed to ips beetle species, and correlated with a widespread drought. Within infected ponderosa pine stands, all three forests experienced substantial tree mortality from this outbreak with stand basal area declining by 32 percent, 62 percent and 37 percent for the Coconino, Tonto, and Apache-Sitgreaves National Forests, respectively (Negrón et al. 2009). Also observed was a reduction in tree density, SDI and average tree diameter. Probability of tree mortality was positively correlated with initial tree density and negatively correlated with elevation and initial average tree diameter (Negrón et al. 2009).

Dwarf Mistletoe

Southwestern dwarf mistletoe incidence has increased on all three Forests, with an estimated 47 percent, 52 percent and 32 percent of commercial acres infected in the 1980s for, the Tonto, Apache-Sitgreaves, and Coconino National Forests, respectively, versus only 19 percent 41 percent, and 30 percent, respectively, in the 1950s (Lynch et al. 2008, Lynch et al. 2010, Lynch et al. 2015). High dwarf mistletoe ratings increase tree stress and the likelihood of ips beetle attacks during drought (Kenaley et al. 2006, 2008). The prevalence of Southwestern dwarf mistletoe seems to be particularly high along the Mogollon Rim. For instance, incidence of mistletoe is higher on the Mogollon Ranger district than on any other district on the Coconino (48 percent of commercial timber infected) and is higher on the Black Mesa district than on the Lakeside district (Hessburg and Beatty 1985, as reviewed in Lynch et al. 2008, 2010).

Denser stand conditions and fire suppression have increased mistletoe abundance in current forest stands, despite the fact that its distribution has likely not changed extensively (Dahms and Geils 1997).

Alternative 1 – No Action

Alternative 1 is the no action alternative as required by 40 CFR 1502.14(c). There would be no changes in current management and the forest plans would continue to be implemented. The effects of 469,036 acres of mechanical vegetation treatments, 567,935 acres of prescribed fire and 122,264 acres of other activities in the form of past and ongoing projects would continue to impact the landscape. Approximately 111,243 acres of vegetation treatments, 166,516 acres of prescribed fire projects, and 48,961 acres of activities in other projects would continue to be implemented in the reasonably foreseeable future within the project area. It is expected that when these actions are completed that these acres would be moving towards the desired conditions. Alternative 1 is the point of reference for assessing action alternatives 2 and 3. The thinning and prescribed fires treatments in the prior 10-year period were designed to set up the stands to reach their desired conditions according to the then approved forest plans. In conjunction with mechanical treatments, there were prescribed fire only treatments designed as fuels treatments to reduce surface fuels as well as reduce ladder fuels and crown fire risks. To those ends, the prior treatments would move the treated acres toward their desired conditions.

Timber Harvest

Past timber harvest practices influenced vegetation structure, pattern, and composition on the majority of the project area. The focus on even-aged forest management continued until the mid-1990s, leaving the legacy of current forest conditions. Approximately 50 percent of the project area that received some type of regeneration or shelterwood harvest has regenerated. Many of these stands are two-aged, dense, and lack age class diversity as a result of these historic practices. Historically, wildfire would have maintained a diverse matrix of age class diversification. Reintroduction of an historical fire return interval would aid in converting, and maintaining, an uneven-aged forest at the landscape level. Currently planned forest treatments should move these stands towards a trajectory for their desired conditions. Untreated stands would continue to move away from desired conditions as densities increase, beetle risks increases and risks of crown fire increase. Under alternative 1 the potential for uncharacteristically large scale wildfires that dramatically impact the landscape is increased.

The Cragin Watershed Protection Project on the Coconino National Forest would mechanically treat 41,046 acres and apply prescribed fire to 63,656 acres to move stands in that project area towards the desired condition. In most cases, fuels reduction treatments do not necessarily provide adequate change in stand structure and do little to move towards desired conditions. However, fuels treatments following mechanical treatments to balance age classes provide the best chance to set these stands on a trajectory towards desired conditions. The Haigler Fuels Analysis on the Tonto National Forest planned to treat over 43,000 acres with mechanical and prescribed fire, but is still in the scoping phase and no impacts can be assigned other than to say that there is a need to reduce high fuel loadings and return to a natural regime.

Forest Structure

In Alternative 1few treatments would be implemented to create a mosaic of interspaces and tree groups. In locations not identified for treatment under other decisions, existing interspace would continue to be reduced by expanding tree crowns and increased tree densities. Understory vegetation response would be suppressed. The risk of undesirable fire and/or effects would continue to increase. Any large scale tree mortality occurring has the potential to enhance interspace and create tree groups. While the forests in the project area have an emphasis to favor uneven-aged management, this silvicultural system does not assure interspaces and groups. These forests have latitude to create openings and groups but have not implemented large areas of openness to date except within WUI treatments. In terms of a mosaic of interspaces and tree groups at the landscape level the prior treatments have not significantly moved the forest towards the desired conditions at this time.

Forest Structure - All age and size classes represented

Prior thinning treatments with restoration objectives were similar to the goshawk habitat and MSO restricted other habitat treatments proposed under the first EIS as well as this project and have resulted in similar diversity in age and size class, and should move these stands towards desired conditions. Uncharacteristically severe wildfires caused large scale mortality across all age and size classes resulting in a non-stocked or single age class representation. Wildfires that burned with a low severity and prescribed burn only treatments had similar effects to forest structure as the post thinning prescribed fires. Restoration treatments and 4FRI treatments are designed to lessen the probability of these uncharacteristically severe wildfires.

The main objective of thinning with a fuels reduction emphasis was to reduce canopy fuels and the potential for crown fire initiation. Generally, this type of treatment focused on removal of trees in the subordinate crown positions and retaining those trees in the dominant and co-dominant crown positions and any pre-settlement trees. This type of treatment resulted in a moderately open canopy, even-aged forest structure with very little age and size class diversity. Prescribed burning and mechanical fuels treatments associated with the above thinning treatments resulted in periodic tree mortality of seedling/sapling size trees and susceptible pre-settlement trees further reducing age class diversity.

Old Forest Structure

Many prior thinning treatments retained pre-settlement trees and the largest post-settlement trees. Sanitation treatments may have removed some old forest structure. Prescribed burning and low severity wildfire resulted in periodic tree mortality of susceptible pre-settlement trees. Mixed and high severity wildfire killed a large proportion of the old forest structure. Powerline treatments removed any old forest structure that was a hazard to the powerline.

Old forest structure has been reduced over many years by past management practices. The change in direction in 1996 to manage more for an uneven-aged stand structure would aid the forest to reach the Desired Conditions over time. The structure of the past and most of the proposed treatments, while planned out as uneven-aged treatments, would have a distinctly different spatial layout than is being planned in this project. Treatments designed in the Rim Country project have identified distinct interspaces of varying sizes with groups of varying sizes as well as randomly spaced trees to aid in forest diversity (horizontal and vertical) while at the same time breaking up areas of continuous canopy to reduce risks to crown fire. Past uneven-aged treatments would have trees more uniformly spaced with more of a closed canopy (moderately closed to closed).

Forest Process

Past thinning treatments resulted in low to moderate stand density index, which is associated with minimum competition between trees, and maximum individual tree growth. This in turn had a beneficial effect of improved forest growth, and reducing the potential for density- and bark beetle-related mortality. Where they occurred, thinning treatments also removed dwarf mistletoe infected trees, reducing the percent of trees infected as well as potentially creating conditions that slowed or inhibited mistletoe spread, even if only for a couple of decades (Conklin and Fairweather 2010). Prescribed fire and low severity wildfire also led to localized reduction of forest density and dwarf mistletoe infection (Conklin and Fairweather 2010). The thinning treatments reduced risks associated with dense forest conditions and improved resilience to the impacts of large-scale disturbance under drier and warmer conditions (Zhang 2019).

Alternatives 2 and 3

Alternative 2 restoration treatments would contribute an additional 953,130 acres toward improving forest health and vegetation diversity/composition, sustaining old forest structure over time, and moving forest structure toward the desired conditions within the cumulative effects area.

Alternative 3 restoration treatments would contribute an additional 529,060 acres toward improving forest health and vegetation diversity/composition, sustaining old forest structure over time, and moving forest structure toward the desired conditions within the cumulative effects area

Prescribed Fire

Prescribed fire is considered to be an integral component to stand treatments and is a necessary complimentary treatment to mechanical treatments to attain and maintain the desired conditions. Without prescribed fires it would be more difficult to maintain desired conditions or reduce unintended results from uncharacteristically high wildland fire at the landscape level. Approximately 40,000 acres of prescribed fire would be implemented annually across the project area from a combination of this project as well as other projects such as Cragin Watershed Protection Project and the Haigler Fuels Analysis.

For the analysis period, prescribed fire (Table 25 and Table 26) such as broadcast burns reduced fuels, modified fire behavior, and lowered crown fire risks. The majority of these acres occurred since 2004 and many may require reintroduction of a prescribed fire within the next 5 years in order to maintain the benefits of the prior burn. The proposed acres of mechanical treatment and/or prescribed fire of the Rim Country 4FRI project (953,130 acres in Alternative 2 and 529,060 acres in Alternative 3), combined with the reasonably foreseeable treatments proposed (Table 57, 166,516 acres) would reduce uncharacteristically severe fire behavior on approximately 1,119,646 acres in Alternative 2 and 695,576 acres in Alternative 3 over the next 20 years. The prior treatments should allow prescribed fire-only treatments, with burns within the same stands as this project, to reduce emissions. Cumulatively, the prior treatments and the proposed prescribed fire create some of the best possible outcomes to reduce undesirable fire behavior and/or effects.

Forest Structure

From the 1970s until 1996 treatments were designed primarily to manage for even-aged stand structure. Alternatives 2 and 3 would treat the area to move stands towards an uneven-aged structure where possible. Treatments after 1996 had an uneven-aged silviculture emphasis and those treatments have moved those stands towards their desired conditions at the time of treatment. When added to projects like CC Cragin and Haigler Fuels Analysis structure would be improved under alternative 2 and to a lesser extent under alternative 3. Prior treatments have reduced densities within and outside PFAs, but very little treatment has occurred within MSO PACs and Cores. Stands treated prior to 1996 would be treated within this proposal as the project moves these stands towards an uneven-aged structure and putting them on a trajectory to achieve their Desired Conditions, with Alternative 2 treating approximately 424,000 more acres than alternative 3. Cumulatively alternative 2 improves stand structure more than alternative 3.

Most past treatments in the cumulative effects area left the forest with denser stands when compared to the proposed restoration treatments in this project. Spatially, the prior treatments, until recently, focused on a uniform distribution of trees with only natural canopy gaps and meadows for openings. When added to more recent past treatments the restoration prescriptions in alternatives 2 and 3 would leave a more open forest, post treatment, than was prescribed in past treatments, with distinct interspaces, groups, and regeneration openings of varying sizes as well as randomly spaced trees across the landscape to enhance structural diversity. Due to fewer acres being treating in alternative 3 the cumulative effects would occur on few acres. Planned interspaces would average between 10 to 90 percent at the stand level from closed forests to open grasslands in both alternatives. The proposed restoration treatments are a departure from past management and have desired conditions for interspaces and groups that would move these stands towards the LMPs Desired Conditions.

Forest Health

Density related mortality

Stand density is a dominant factor affecting the overall health and vigor of conifer forests in the western US (SAF 2005) and high stand densities leads to reduced ecosystem resilience (Reynolds et al 2013).

Prior treatments have used prescriptions, both even-aged and uneven-aged, to reduce stand densities. Table 25 and Table 26 lists some of the treatments that were or will be completed in the analysis area during the analysis period and most all vegetation manipulation treatments were designed to reduce stand densities to some extent. Even with the reduced stand densities some stands were susceptible to the drought period during the early 2000's. This is probably an indicator of stand behavior at these treatment densities in context with climate change. Because of these treatments these stands have moved towards the desired conditions. However, not all were designed as a restoration treatment, especially those implemented earlier in the analysis period. Therefore, these stands may not be moving towards the restoration desired conditions of this project and could be treated again in order to aid in moving them to their desired conditions, or onto a trajectory to achieve the desired conditions.

Proposed treatments in the foreseeable future would be more closely allied with a restoration-based desired condition and prescription such as that in the Rim Country project. The newly published Forest Plans of the Coconino and Apache-Sitgreaves National Forests clearly spell out the intent to treat widely across the forest with a restoration desired condition. The foreseeable acreages for projects such as Cragin Watershed Protection Project and the Haigler Fuels Analysis demonstrates this intent. When this is combined with the foreseeable treatments (Table 27) Rim Country treatments (Table 25 and Table 26) would move a considerable portion of the landscape towards a desired condition of reduced stand densities with an open grass/forb/shrub matrix in a heterogeneous landscape. These changes would occur in both alternatives, however in alternative 3 the movement toward the desired condition would only occur on the treated acres.

Bark beetle related mortality

Bark beetles are normal endemic insects in ponderosa pine and mixed conifer communities and the pine type has evolved with such disturbances (Reynolds et al 2013). But when conditions are conducive to beetle outbreaks insects can become a strong determining factor in stand structure and composition that can become even more pronounced during and following extended droughts and under dense stand conditions (Reynolds et al 2013, Negrón 1997). Consult USDA (2014) for a history of epidemic bark beetle infestations within the analysis are from the 50's thru 2014. The current stand structures reflects the occurrences of these epidemic outbreaks.

Prior treatments within the analysis area were completed with a desire to reduce hazardous fuels and reduce stand densities. The drought period from 2000 until now has challenged many stands with bark beetle infestations. The current conditions are still dense in many stands as attested to by their high SDIs. Post 1996 treatments were effective in reducing density related mortality. Even with the reduced densities some stands were susceptible to the drought period during the early 2000's. Rim Country treatments would further restructure stands towards the restoration-based desired condition and when added to the past treatments this should aid in relieving further stresses in both alternative's 2 and 3, but in more stands in alternative 2. Because bark beetles can fly considerable distances and have multiple generations in one season, treatments outside, and adjacent to, the analysis area would have an important influence of beetle activity within the analysis area.

Dwarf mistletoe infection

Activities identified in Table 25, Table 26 and Table 27 treat acres mechanically and with the use of prescribed fire. Many of these treatments had a considerable effect on the distribution, but more importantly, the abundance of dwarf mistletoe. Mitigation strategies for dwarf mistletoe (DM) attempt to reduce stand dwarf mistletoe ratings (DMR). Where DM is present, silvicultural prescriptions prioritize removal of infected trees (at or above a predetermined infection level). Due to the limited transmissivity of dwarf mistletoe, treatment of stands outside the analysis area do not have as great a potential impact to DM spread in the analysis area as do stands adjacent to the analysis area. While seeds of the dwarf mistletoe are forcibly ejected, the spread of DM throughout and between stands is relatively slow (Conklin 2000). However, infection from outside of the analysis area from adjacent stands and into stands within the analysis area is possible, though infections outside the analysis area would have little impact to growth or mortality to the overall analysis area.

Prior treatments within the analysis area would have reduced, but not eliminated, DM from the treated stands. The DM infections would continue to slowly intensify. Foreseeable treatments would potentially reduce infection levels further and would benefit the overall analysis area in terms of improved tree growth and vigor and reduced bark beetle risks. Where possible, the Rim Country project would target stands with moderate and severe DM infections at an appropriate intensity level to lower the infection rating. Infected trees can grow at near the rate of uninfected trees on good sites if individual tree infections remain at or below a dwarf mistletoe rate of 3 (Hoffman 2010). Combined with other treatments in the cumulative effects area such as Cragin Watershed Protection Project and Haigler Fuels Analysis, occurrence of dwarf mistletoe infection severity would move towards desired conditions. However, DM is a natural component of the ponderosa pine and dry mixed conifer communities and eradication is neither desirable nor possible, and latent infections (those not visible at the time of treatment) would remain within the stands.

Other Direct and Indirect Effects

Climate change

Risks associated with dense forest conditions would be reduced and resilience to the impacts of large scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under alternatives 2 and 3. Prior treatments would benefit the forest by reducing densities and reducing stresses associated with completion. Treated forest would be more resilient to climate change than untreated forest (Kerhoulas et al 2013). Within-forest carbon stocks would be reduced under alternatives 2 and 3, however large scale stand replacing wildfires such as the Rodeo-Chedeski and Wallow fires that emitted enormous amounts of carbon dioxide would be less likely to occur. Individual tree growth would improve, resulting in larger average trees size and increased carbon storage over time offsetting short term losses of carbon removed through the mechanical thinning. Some of the carbon biomass removed by mechanical thinning would be sequestered for a considerable period of time in the form of forest products.

Residual Tree Damage
Some damage to residual trees would be expected in Alternatives 2 and 3 with the felling, tractor yarding and piling operations associated with mechanical treatments in ponderosa pine. Damage rates should be similar or less than current silviculture practices due to the more open conditions created. The Proposed Action would result in the most potential damage because of the extensive harvesting in overly dense stands. Damage would be minimized through contract administration, on-site inspections, and proper harvest methods. All piling and/or low-severity burning treatments would reduce understory stocking and reduce inter-tree competition as well as stimulate understory vegetation (shrubs, forbs, grasses). Prescribed fire is expected to damage some residual trees and increases short-term risks to low level bark beetle activity.

Fire Ecology and Air Quality

Only a summary of the fire ecology analysis is presented here. The Fire Ecology and Air Quality Specialist Report includes the complete analysis and is incorporated by reference.

Affected Environment

Background and Historic Conditions

Across the Rim Country landscape, the disruption of Fire Regimes over the last century is largely responsible for the deteriorating health of the ecosystems in Northern Arizona (Covington 1994). In the latter part of the 19th century, unsustainable practices in fire management, grazing, and logging began to change the structure and composition of landscapes, making them more homogenized. As a result ecological functions are now impaired across the landscape of northern Arizona (Leopold 1924; Covington 1994; Heinlein *et al.* 2005; Rodman *et al.* 2017).

Fire is a keystone process affecting the ecological functions of large areas. As Europeans settled into the area, roads and trails increasingly broke up the continuity of surface fuels and contributed to the reduction of the frequency and size of wildfires (Covington and Moore 1994). Long periods without fire changed the species composition and fuel structure of southwestern ecosystems (Swetnam 1990b; Huffman 2017). There are about 800,000 acres of cover types targeted for restoration in Rim Country that historically were maintained by frequent fires.

Fire Occurrence & Fire Regime

There is little doubt that fires, started by lightning or by Native Americans, were frequent before the arrival of the Europeans and in the early years of settlement. Historically, fires occurred frequently, with return intervals ranging from a few years to a decade or more. These historic fires were typified by low severity. Not until the mid-20th century were a limited number of large scale stand replacing fires recorded (Cooper 1960).

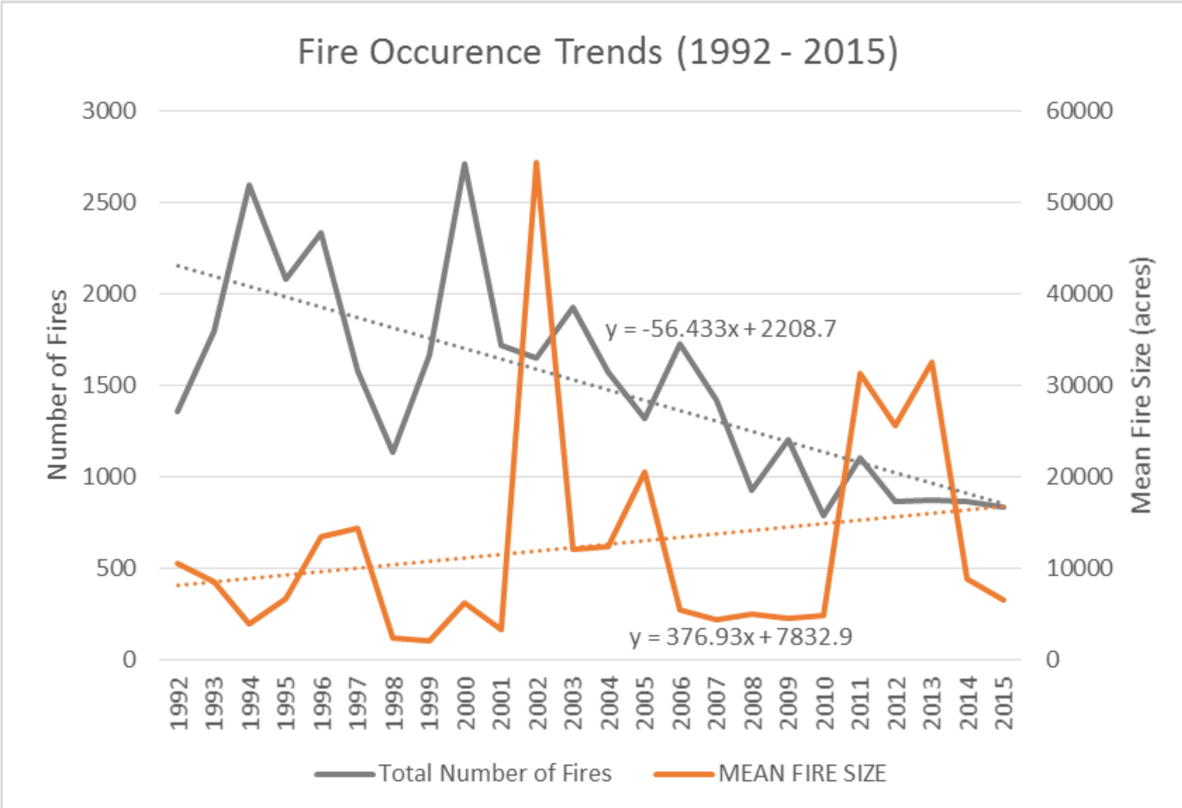


Figure 44. Trends in mean fire size and total number of wildfires from 1992 to 2015

Contemporarily, the number of fires reported in and adjacent to the project area has decreased over the last 25 years (1992 – 2015), while the average size has increased (Figure 14). While fire size is certainly an indicator of the trends in wildfire, it is primarily those areas that burn with uncharacteristic severity that are of concern.

Currently, the number of acres burning with high severity is much larger than historic data indicates was typical of ponderosa pine in the southwest (Weaver 1951; Covington 1994; Swetnam and Betancourt 1998; Westerling *et al.* 2006). Of the annual acres burned by large fires since 1992, about 73 percent burned at low severity on average, and 27 percent burned at moderate to high severity. However, the 2002 Rodeo-Chediski fire, which burned with a much higher percentage of moderate and high severity, serves as an outlier to this pattern. Overall, the annual acres burned by large fires has increased since 1992 (Figure 45), while the proportion of acres burned in each severity class has remained about the same (Figure 46). If these patterns continue into the near future (10 years), the total acres of high severity fire is likely to increase proportional to fire size increases.

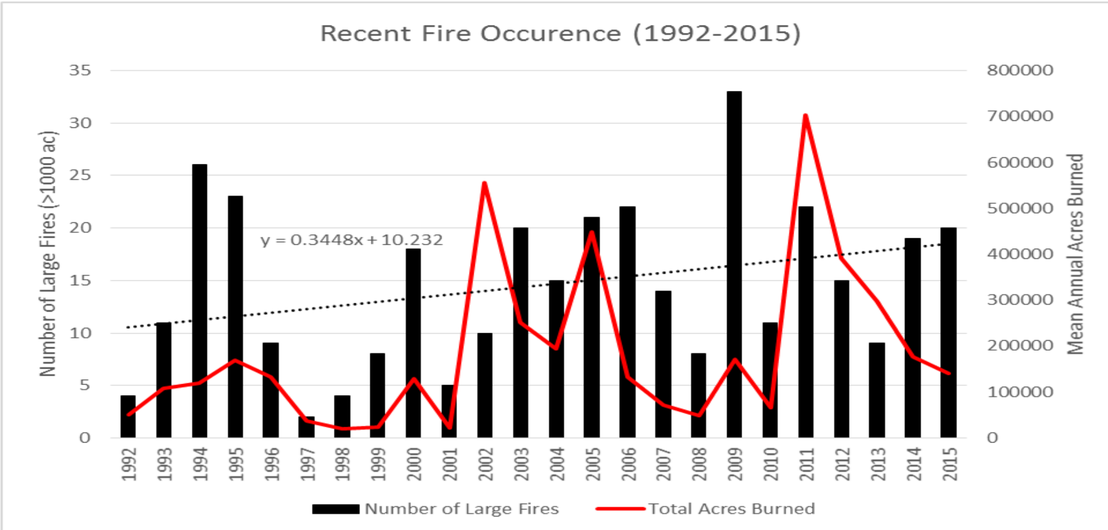


Figure 45. Trends in the number of large fires (>1,000ac) and total acres burned from 1992-2005 within the Arizona/New Mexico Mountains Ecoregion

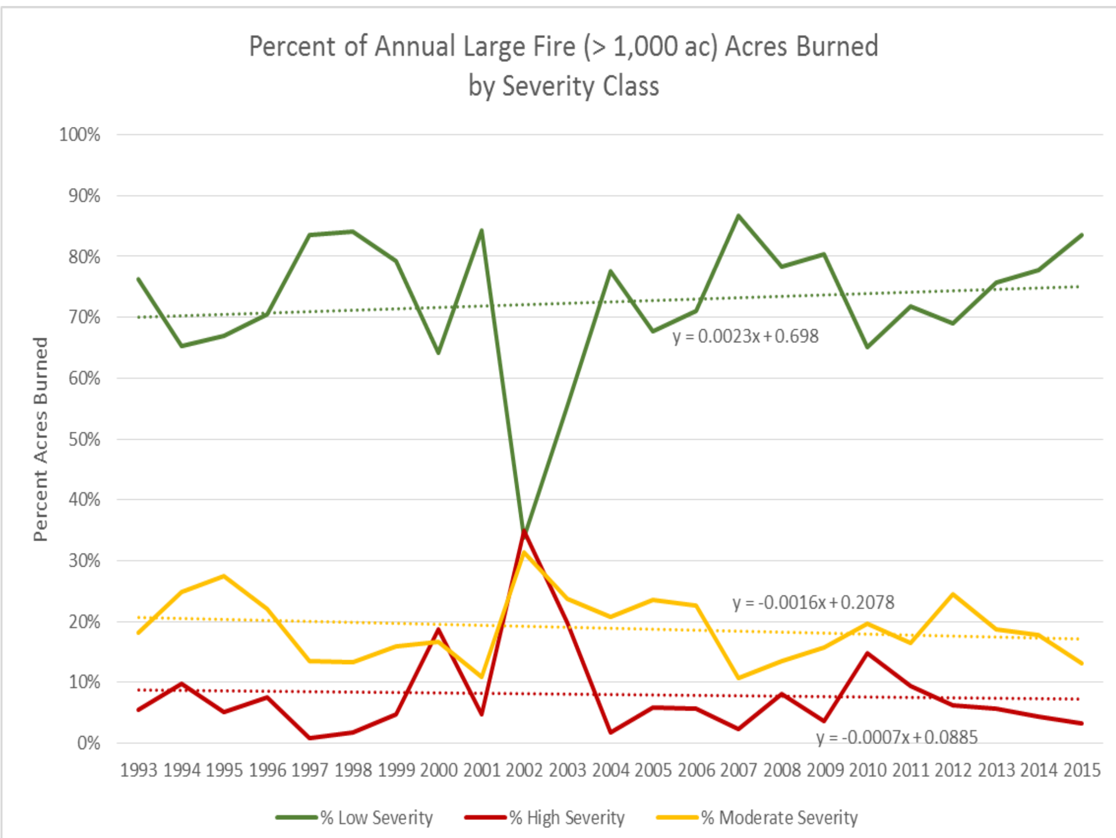


Figure 46. Percent of annual large fires burned by severity class

Figure 47. Conditions in dry mixed conifer in the project area that could easily support high severity fire

Figure 48. Locust dominated area in the Sierra Anchas where the Coon Creek Fire produced high severity effects in 2000

Areas of high severity fire can have detrimental impacts that extend far from the actual fire perimeter both temporally and spatially. Many of the areas that burned under high severity have been slow to regenerate and in places are now dominated by herbaceous and shrubby vegetation such as New Mexican Locust (*Robinia neomexicana*) (Figure 48). High severity fire, especially over large areas also leaves surface soil layers vulnerable to erosion. Additionally, debris flows and floods associated with severely burned areas may have severe, long term effects on areas downstream, downslope, and adjacent to the burned area.

Current conditions inhibit the survival and recruitment of large trees by fueling increasingly extensive high severity fires. These fires have the potential to alter the successional trajectories of post-burn vegetation, creating entirely different communities than those existing before such events (Savage and

Mast 2005; Strom and Fulé 2007b; Kuenzi *et al.* 2008). Figure 47 shows dense forest conditions (numerous trees with dense, contiguous canopy fuels) that occur within the project area and would support high severity fire. Even without crown fire, a surface fire burning though this area could do enough damage to trees to cause widespread mortality (Van Wagner 1973).

Fire Return Interval (FRI)

Fire Return Interval (FRI) can be used as a coarse indicator of how departed an area is in regards to the fire regime. The FRI calculated for this analysis does not take into account seasonality, severity, size, spatial complexity, or other important characteristics of a fire regime. However, particularly when combined with cover type/s, and severity, it is a useful indicator for evaluating how far an area has departed from a sustainable fire regime.

Fire Return Interval is a component of the fire history of an area. The Mogollon Rim, and the Sierra Anchas areas have a high density of ignitions, both lightning and human. In the past 31 (1987 – 2017) years, 850,215 acres of the 1,238,658 acre project area burned, for a mean annual acres burned of 27,426 acres. In addition to wildfire, 242,028 acres of Rx fire have occurred in the project area from 1995 – 2018 for another 10,084 acres per year. Prescribed fire is often focused on areas strategic to values at risk, and therefore is concentrated on the landscape, rather than distributed throughout (Figure 49). Taken together, the mean fire return interval for the entire project area is 33 years.

For Montane Ponderosa Pine forest types, the recent FRI is 38 years. This is almost double the desired maximum average for maintenance burning in ponderosa pine on the Mogollon Rim. The FRI is 59 years for Ponderosa Pine-Evergreen Oak, 65 years for dry mixed conifer, and 113 for grasslands in the project area. These FRIs represent an average that includes areas that have burned much more frequently and areas that have burned at a much longer frequency. These higher than natural fire return intervals have contributed to the degree of departure from historic conditions that puts over 51 percent of the area proposed for treatment area at risk of moderate to high severity fire effects based on recent severity proportions.

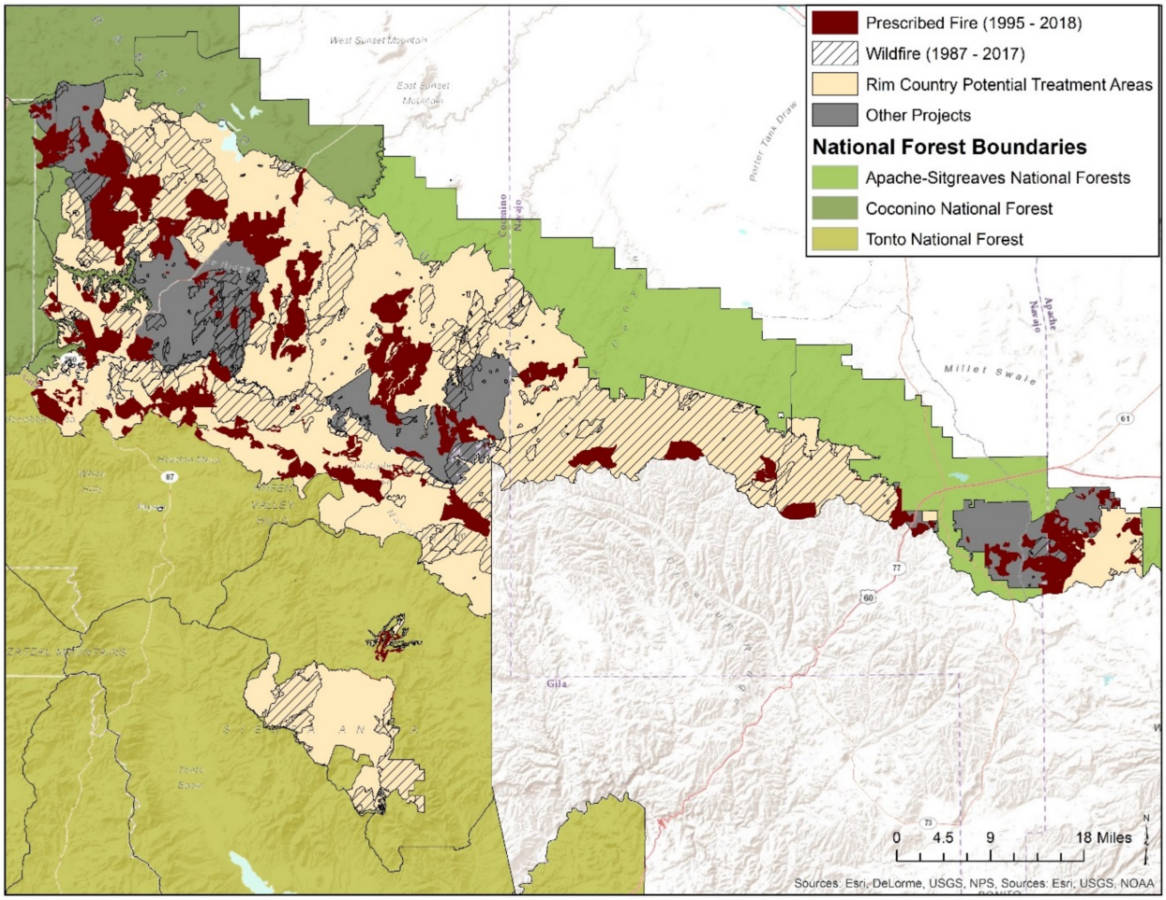


Figure 49. Location of recent wildfire (1987-2017) and prescribed fire (1995-2018) within the project area

Table 29: Vegetation cover types targeted for restoration, and their desired and current fire regimes across the project area

Cover type	Acres of each cover type	FRI Desired (average)	FRI Current+	High Severity Fire: Desired %	High Severity Fire: Recently Burned w/ High Severity++	High Severity Fire: Expected to Burn with High Severity	Average Annual Acres burned +	Average annual acres needed to burn to meet desired conditions
Ponderosa Pine (montane)	543,058	2 – 22 (12)	38	< 20 (<5% active crown fire)	27% High	23% active crown fire	14,495	~45,000
Ponderosa Pine – Evergreen Oak**	146,445	1 – 60 (7)	59	< 25 (with <10% active crown fire)	29% High	36% active crown fire	2,477	~20,000
Dry Mixed Conifer	47,993	2 – 61 (15)	65	< 20 (with <7% active crown fire)	19% High	54% active crown fire	743	~3,200
Aspen	1,436	5 - 150	739	N/A	N/A	17% active crown fire	2	~15
Grasslands	43,000	2 – 40 (12)	113	<10%	12% High	<1% active crown fire	379	3,600
Riparian	9,931	Related to, but not the same as, adjacent cover types.	Related to, but not the same as, adjacent cover types.	Related to, but not the same as, adjacent cover types.	Related to, but not the same as, adjacent cover types.	Related to, but not the same as, adjacent cover types.	N/A	N/A

+ Average calculated across all stands with that cover type for the past 30 years (1987 – 2017) for wildfire plus the past 24 years (1995 – 2018) for prescribed fire

++Data from Monitoring Trends in Burn Severity from 1992 – 2015

**Evergreen Shrub Subclass included in acres, but not in desired condition surface wind speed, which, in turn, affects surface fire intensity and rate of spread. Across the project area, canopies have become much more closed, resulting in elevated potential for crown fire and decreased surface vegetation.

Surface fuels

Historically, fine surface fuel loads were made up primarily of herbaceous material and fire burning though it would move relatively quickly, with a short residence time and a high rate of consumption. Repeated fires would consume coarse woody debris a little at a time, allowing natural recruitment of more from branches or snags to maintain equilibrium based mostly on fire frequency. (Covington and Sackett 1984).

Currently, across much of the project area, surface fuels are dominated by needle litter and duff that has accumulated over years to decades and is more closely packed than herbaceous fuel. Fire burning through these fuels will have a longer residence time than in herbaceous fuels, and the lower layers may smolder for extended periods, transferring more heat to the soil, roots, and boles of trees (Lutes *et al.* 2009, Valette *et al.* 1994; Sackett and Haase 1996). Litter and duff cones have accumulated around the base of many large and/or old trees in the project area and are likely to cause, or contribute to, undesirable mortality (Egan 2011). Prescribed fire can produce fire behavior that is less likely to cause lethal damage.

These fuel layers cannot be addressed by mechanical means across the entire area proposed for treatment under any of the action alternatives, even if it was ecologically sound to do so. Mechanical treatments may move duff and litter around, creating temporary discontinuities in the surface litter layer, but the biomass remains on site.

Wildfire Management

Initially, and through most of the 20th century, wildfires burning in frequent fire regimes in the Southwest were relatively easy to suppress. Fuels were mostly light and flashy, and forests were open with high canopy base heights, and suppression was a common response. Many areas were increasingly overgrazed to the point where some areas couldn't burn at all and/or fires were easy to suppress. Settlers saw fire as a threat, and actively suppressed it whenever they could. The subsequent accumulation of fuel, through litter-fall, logging debris, and development of ladder fuels that can initiate crown fire (Covington and Moore 1994) made fire suppression more difficult. As wildfires became more difficult to suppress, firefighting technology, tactics, strategies, equipment and support improved dramatically, allowing suppression forces to succeed in suppressing all but the most intense and extreme fires.

Wildland Urban Interface

The Wildland Urban Interface (WUI) is the area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels ((NWCG) 2018). It is that portion of the landscape where structures and vegetation are sufficiently close that a wildland fire could spread to structures, or a structure fire could ignite vegetation. Many WUI areas are scattered across the project area, though areas of the greatest concern are relatively focused around towns or along travelways. For this analysis, the wildland urban interface is defined by a 0.5 mile buffer surrounding non-Forest Service lands where structures are present (Figure 50). Other critical infrastructure (Transmission Lines and Communication sites) and high value Forest Service Infrastructure (Buildings and Recreation Sites) were also included within the WUI for this project.

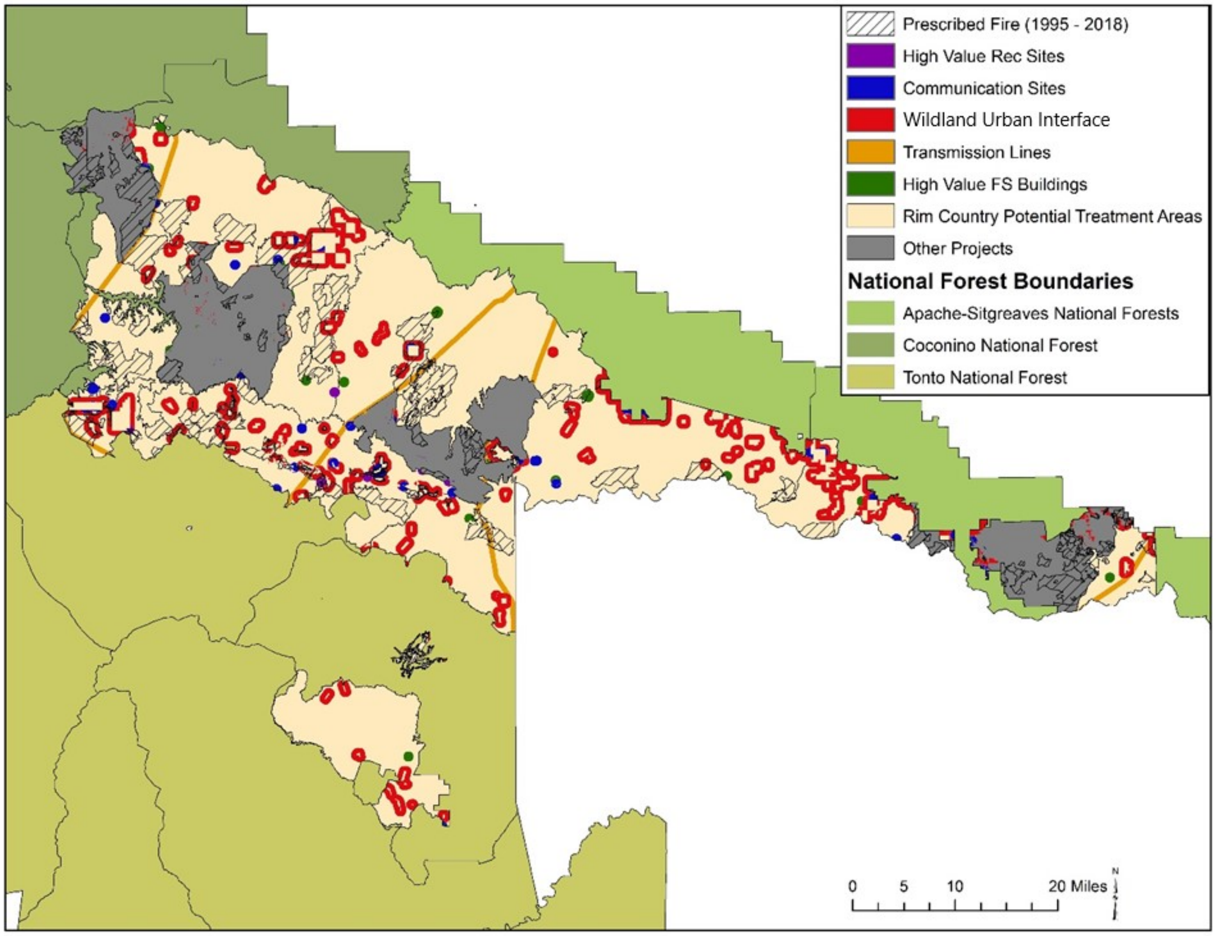


Figure 50. Wildland urban interface, as defined and mapped by the project. Recent prescribed fires are shown by hashed polygons.

Large and/or old trees

Large and/or old trees in the project area increase structural diversity, improving habitat for birds, insects, and other animals. Old trees have greater genetic diversity than even-aged groups of young trees, and provide forests a better chance of adapting to changing climate conditions and other environmental stressors (Minard 2002). Large and/or old trees within the project area are threatened by the increasing size and severity of wildfires.

Crown damage is an important factor in the mortality of old trees for which the death is attributed to fire (Fowler and Sieg 2004; Haase and Sackett 2008; Hood 2010b). The proximity of dense young trees and ladder fuels is problematic because it is so wide spread. In the transitional pine areas various species of juniper and oak are components of the forest, often centuries old. The overtopping of these trees by ponderosa pine allows a buildup of needles in the crotches and forks. This can lead to greater mortality and/or damage to very old trees when highly flammable needle accumulations burn than would occur without the needle accumulations.

Vegetation Cover Types

Ponderosa Pine (Montane)

This cover type includes all ponderosa pine other than the ponderosa pine/evergreen oak and transitional pine described in the next section. There are about 543,058 acres of this kind of ponderosa pine forest within the area being considered for restoration treatments.

Fire Ecology

Ponderosa pine forests are widespread in the Southwest occurring at elevations ranging from 6,000-7,500 feet on soils from igneous, metamorphic, and sedimentary parent materials with good aeration and drainage, and across elevational and moisture gradients. The dominant species is Ponderosa pine (*Pinus ponderosa* var. *scopulorum*). Other trees, such as Gambel oak (*Quercus gambelii*), pinyon pine (*Pinus edulis*), and juniper (*Juniperus* spp.) may be present. There is sometimes a shrubby understory mixed with grasses and forbs, although this type sometimes occurs as savannah with extensive grasslands interspersed between widely spaced clumps or individual trees. Canopy cover in the savanna areas is between 10 and 30 percent.

Historically, once fires ignited in ponderosa pine forests, they could burn until extinguished by rain, or until they ran out of fuel, which typically occurred when they reached an area that had recently burned. Fires could burn for months and cover thousands of acres (Swetnam and Betancourt 1990; Swetnam and Baison 1996; Swetnam and Betancourt 1998). Effects from these long burning fires would vary as conditions changed over the weeks or months they burned. As a result, most ponderosa pine in the southwest burned every 2 to 22 years as mostly low-severity, often area-wide fires (Weaver 1951; Cooper 1960; Deterich 1980; Swetnam *et al.* 1990; Swetnam and Baison 1996; Covington *et al.* 1997a; Fulé *et al.* 1997; Heinlein *et al.* 2005; Kaib 2011).

History

Although the popular early descriptions of the ponderosa pine forest call attention to the park-like stands, there are some descriptions which refer to areas with dense cover (Woolsey 1911). An accurate picture of the pre-settlement ponderosa pine forest would probably describe a mosaic of mostly open, grass savanna and clumps of large, yellow-bark ponderosa pine and open forest with an occasional dense patches or stringers of small, blackjack pines (young ponderosa pine).

Extensive stand-replacing fires are unreported in the documentary records prior to circa 1950 (Cooper 1960; Allen *et al.* 2002a). Ponderosa pine does not sprout, so crown fire generally produces 100 percent mortality. There are few data available to indicate how much high severity fire was typical across the ponderosa pine in northern Arizona, but simulations suggest that presettlement forest structure would have supported very little crown fire, passive or active (Roccaforte et al. 2008, Covington 2002).

The ponderosa pine/evergreen oak (PPEO) cover type in this analysis includes vegetative associations which have been referred to by various classifications and names, including transitional pine, Arizona highlands, Ponderosa Pine/Evergreen Oak ERU, Mogollon highlands, various Madrean fringe types (Fleischner *et al.* 2017; Wahlberg *et al.* 2017 (in draft); Huffman *et al.* 2018). In order to be consistent, this analysis will use the broadest classification, ‘Ponderosa Pine/Evergreen Oak’ (PPEO) to refer to this broad cover type, with more detailed discussion as needed to include unique characteristics.

It is well understood that 20th century fire exclusion in montane ponderosa pine forests has led to substantial increases in tree establishment and associated changes in ecological function (Covington and Moore 1994; Fulé *et al.* 1997; Moore *et al.* 1999; Savage and Mast 2005; Strom and Fulé 2007a). Much less is known about historical changes associated with modern land use in the PPEO. It appears that cover of long-lived sprouting shrubs has increased in many transitional ponderosa pine forests as a result of fire exclusion (Huffman *et al.* 2018).

Mixed Conifer

Mixed Conifer includes a wide range of vegetation types and fire regimes. Mixed conifer has been classified into warm/dry, or cool/moist (Romme *et al.* 2009; Korb *et al.* 2013; Wahlberg *et al.* 2017 (in draft)), which can also be distinguished by their natural fire regimes. In this analysis, mixed conifer will be referred to as WMC (Mixed Conifer with Aspen, or Wet Mixed Conifer) or DMC (Mixed Conifer - Frequent Fire, or Dry Mixed Conifer).

Historically, mixed conifer in the southwest had highly diverse composition and structure. This diversity was largely driven by topography, with the scale of the mosaic of cover types dependent on the scale of topographic variation. Ridgetops and low elevation sites were (and largely still are) characterized by open stands dominated by ponderosa pine and had frequent surface fires. South and west-facing slopes likely were similar, but were less open and had less ponderosa and more Douglas-fir, aspen and white fir. These stands likely also were characterized by frequent surface fires. North and east-facing slopes were likely more dense and had still less ponderosa and more white fir, as well as Engelmann spruce and subalpine fir, especially at higher elevations.

Mixed Conifer with Frequent Fire (Dry Mixed Conifer)

Dry Mixed Conifer (DMC) covers approximately 63,000 acres within the area proposed for treatment in Rim Country. It generally occurs at elevations between 6,000 and 10,000 feet, with some variability depending on aspect. DMC is generally situated between ponderosa pine or pinyon-juniper woodlands below wetter mixed conifer or and spruce-fir forests above. Historically, DMC was dominated by ponderosa pine (*Pinus ponderosa* var. *scopulorum*) in an open forest structure (Reynolds *et al.* 2013; Rodman *et al.* 2016; Huffman *et al.* 2018), with minor occurrence of aspen (*Populus tremuloides*), Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and Southwestern white pine (*Pinus strobiformis*).

Fire Ecology

Historical fire regimes were probably similar to those widely reported for montane ponderosa forests of the Southwest. Frequent surface fires likely kept forests in open structural conditions and limited the abundance of woody understory species. Available evidence in DMC forests suggests that high severity patches would have been generally been less than 60 acres, with the larger patches being less common (Huffman *et al.* 2015; Yocom Kent *et al.* 2015).

History

The historical fire regime on this landscape was one of high frequency, low-severity fires (Huffman *et al.* 2015). This would have supported a finer grained pattern of vegetation than is currently present. Current conditions show a coarser pattern that would be more consistent with a less frequent, mixed to high severity fire regime, increasing the susceptibility to stand-replacing fire, even where such regimes were uncommon historically (Abella and Springer 2014; Rodman *et al.* 2016). Fire and drought tolerance have decreased since pre-settlement times, driven largely by increases in the relative importance of white fir (*Abies concolor*) and southwestern white pine (*Pinus strobiformis*), but also shifts from shade intolerant species to shade tolerant species (Strahan *et al.* 2016).

Emissions and Air Quality

Wildland fire emissions can cause adverse health effects and/or become a nuisance, but are fundamental to the disturbance ecology associated with healthy ecosystems that are adapted to frequent fire. Fire will occur in the project area in some form, regardless of the decision made based on this EIS, so air quality impacts are evaluated for all the alternatives. Air quality within the project area currently meets EPA air quality standards.

Wildfire vs. Prescribed Fire

Smoke is inevitable in the airsheds of fire adapted ecosystems, such as those of Northern Arizona. Federal land managers have the role of protecting and meeting air quality standards while simultaneously allowing fire, as nearly as possible, to function in its natural role in the ecosystem (USDA and USDOI 1995). Smoke and visibility impairment from wildland fire that closely mimics what would occur naturally is generally viewed as acceptable (Peterson 2001).

Currently, prescribed fires are regulated and their emissions are monitored and regulated in the same manner as emissions sources that are more controllable (such as dust, vehicle emissions, smoke from wood-burning stoves, industrial emissions, etc.), and included in air quality assessments used to approve burn plans. Smoke impacts from wildfire can be more difficult to mitigate than prescribed fire, whether the expected effects of the fire are desirable or not.

Fire managers are able to manage smoke impacts to some degree by implementing prescribed fire when ventilation conditions are favorable. Various Emissions Reductions Techniques (ERTs) are utilized and documented as a standard part of implementing prescribed fires. Prescribed burning is implemented only with approved site specific burn plans and with smoke management mitigation and approvals. All burning is conducted according to Arizona Department of Environmental Quality standards and regulations, including the legal limits to smoke emissions from prescribed burns as imposed by Federal and State Law. The Arizona Department of Environmental Quality ADEQ) enforces these laws by regulating acres that are treated based on expected air impacts. These regulations ensure that effects from all burning within the area are mitigated and that Clean Air Act requirements are met.

Meteorological, Climatological and Topographical Effects on Air Quality

Climatological limits are set by weather and fuel moisture, which profoundly affect fire behavior, fire effects, and the behavior and effects of emissions. As weather varies from year to year, so does the risk of high severity fires and the ability to use prescribed burns and wildfires to achieve resource objectives. Large fluctuations in the number of days of opportunity vary widely from year to year, creating large fluctuations in the number of acres treated with wildland fire. Running averages over many years must be used in order to view trends in fire use or fire effects (Kleindienst 2012).

During the winter, weather conditions can trap emissions in a layer of cold surface air (inversion). Under these conditions, particulates can be trapped close the surface in local airsheds, including the communities of Flagstaff, Young, Payson, Pumpkin Center, Roosevelt, St. John, and the Verde Valley. Visibility is also an air quality consideration, and tends to be lowest in the summer due to regional haze and smoke from fires.

Emissions and Public Health

There are six pollutants identified by the Environmental Protection Agency (EPA) that are considered to be 'fire-related' pollutants (Hyde *et al.* 2017), are: Carbon monoxide, Lead, Nitrogen Dioxide, Ozone, Particulate Matter, and Sulfur Dioxide.

The Clean Air Act establishes National Ambient Air Quality Standards (NAAQS) for six principal pollutants that pose health hazards: carbon monoxide (CO), lead, nitrogen dioxide, particulate matter less than 10 microns in size (PM 10), particulate matter less than 2.5 microns in size (PM 2.5), ozone, and sulfur dioxide. All of these pollutants except lead are monitored and reported by the daily Air Quality Index (AQI), which ranging from Good to Hazardous (Figure 51). This index focuses on adverse health effects from exposure to unhealthy air. Each day, monitors record concentrations of the major pollutants at more than a thousand locations across the country. These raw measurements are converted into a separate AQI value for each pollutant (ground-level ozone, particle pollution, carbon monoxide, and sulfur dioxide) using standard formulas developed by EPA. The highest of these AQI values is reported as the AQI value for that day.

AQI Value	Actions to Protect Your Health From Particle Pollution
Good (0 - 50)	None
Moderate (51 - 100*)	Unusually sensitive people should consider reducing prolonged or heavy exertion.
Unhealthy for Sensitive Groups (101 - 150)	The following groups should reduce prolonged or heavy outdoor exertion: - People with heart or lung disease - Children and older adults
Unhealthy (151 - 200)	The following groups should avoid prolonged or heavy exertion: - People with heart or lung disease - Children and older adults Everyone else should reduce prolonged or heavy exertion.
Very Unhealthy (201 - 300)	The following groups should avoid all physical activity outdoors: - People with heart or lung disease - Children and older adults Everyone else should avoid prolonged or heavy exertion.

Figure 51. AQI table with levels of health concerns. Taken from the Environmental Protection Agency's airnow.gov website: https://airnow.gov/index.cfm?action=aqi_brochure.index

While it is difficult to determine exactly how much emissions from wildfire fires contributes to the overall AQI compared to other polluters such as vehicles, dust and industrial pollutants, trends in AQI can help identify areas with increased need for mitigation of wildfire emissions. The pollutant most directly linked to AQI and wildfires is Particulate Matter (both PM10 and PM2.5).

Particulate Matter (PM)

Air pollutants called particulate matter (PM) include dust, dirt, soot, smoke and liquid droplets directly emitted into the air by sources such as factories, power plants, cars, construction activity, fires and natural windblown dust. This pollutant is the greatest concern of wildland fire emissions, from wildland fire (Ottmar 2001; Graham 2012-2014), although fire also creates other criteria pollutants and visibility impacts. Particulate matter is defined as tiny particles of solid or semi-solid material suspended in the air. Particles may range in size from less than 0.1 microns to 50 microns. Particles larger than 10 microns tend to settle out of the air quickly and are not likely to affect public health; smaller particles remain airborne, are considered inhalable, and have the greatest health effects. The EPA has used 'PM10' since 1987 to refer to particles of 10 micrometers or less in the ambient air. In 1997, the EPA added 'PM2.5', which includes only those particles with aerodynamic diameter smaller than 2.5 micrometers.

The Clean Air Act defines the NAAQS for PM 2.5 as an annual mean of 15µg/m3, and a 24 hour average of 35µg/m3. At this concentration or above, PM 2.5 is considered to have a detrimental effect on public health. It is important to note that it is not the total amount of emissions from a fire that have effects on human health, but rather how concentrated pollutants in ambient air are for a period of time.

Fugitive dust

Heavy equipment used on paved and unpaved roads during the implementation of projects has the potential to create localized impacts from fugitive dust. With high wind events, this fugitive dust has the potential to be carried for several kilometers. Control measures developed for site specific projects can reduce these localized particulate matter emissions, such as 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 (BLM 2011).

Radioactive emissions

During the Cerro Grand fire of 2000, there was also considerable public concern regarding the potential release of radionuclides from fires burning on lands managed by the Los Alamos National Laboratory (LANL). The following risk summary is from "2002 Fact Sheet: Cerro Grand Fire Releases to Air" which may be viewed at:

http://www.nmenv.state.nm.us/OOTS/PR/2011/NMED_Monitoring_Air_Quality_in_Los_Alamos.pdf
"The primary health risks during the Cerro Grande fire were associated with breathing materials released into the air. It was estimated the risk of cancer from breathing any LANL-derived chemical or radioactive material that may have been carried in the smoke plume to be less than 1 chance in 10 million. Potential exposures in the surrounding communities to LANL-derived chemicals that are not carcinogenic were about 10 times lower than acceptable intakes established by the U.S. Environmental Protection Agency (EPA). The risk of cancer from breathing chemicals and radioactive materials in and on the natural vegetation that burned in the Cerro Grande Fire was greater than that from LANL derived materials, but still less than 1 chance in 1 million. The vegetation that burned contained naturally occurring chemicals and radioactive materials and radioactive fallout produced during atmospheric tests of nuclear weapons. These materials and the risks they posed are present during any forest fire. The evidence suggests that some adverse health effects did result from breathing high concentrations of particulate matter in the smoke. Such exposures are associated with any forest fire. Deposition of LANL-derived chemicals and radioactive materials from the smoke plume to the soil was minimal."

Following the Cerro Grande fire that burned the city of Los Alamos and the Los Alamos National Laboratory (LANL) in New Mexico in 2000, the US Environmental Protection Agency (EPA), New Mexico Environment Department (NMED), and LANL partnered with Department of Energy to operate radiological monitoring systems as well as to initiate several studies to assess the impacts of the fire. The results of these efforts with regard to air quality and human health impact indicated that radionuclides originating from the LANL site during the Cerro Grande Fire were restricted to naturally occurring radionuclides.

LANL, the Department of Energy, and NMED monitored radionuclide concentrations in smoke from the Las Conchas fire that burned through the Los Alamos area in the summer of 2011 and reported no significant detection levels (http://www.nmenv.state.nm.us/nmrcb/documents/LasConchasFireAirMonitoring.html).

Mercury

Mercury is present at some background level around the world, and is sometimes present in emissions from wildland fires (Friedli *et al.* 2003; Biswas *et al.* 2007; Wiedinmeyer and Friedli 2007; Obrist *et al.* 2008; Selin 2009; De Simone *et al.* 2016; Webster *et al.* 2016). However, there is insufficient science to support conclusions about specific effects from the prescribed fires proposed in the Rim Country EIS. General conclusions may be possible, but no valid effects could be presented so, even if we did have the means of providing an estimate of mercury emissions, we would still not know the effects.

There is little question that there would be more mercury in emissions from high intensity wildfires than from the low intensity fires that would typify the prescribed fires proposed by the Rim Country (Friedli *et al.* 2003; Biswas *et al.* 2007; Obrist *et al.* 2008; Lahm 2014; Webster *et al.* 2016). Mercury is not a Criteria Pollutant, that is, it is not one of the six substances for which there are National Ambient Air Quality Standards, because it is not considered an 'ambient' substance. Mercury is regulated as a "point source", meaning emissions are regulated by the specific sources which discharge pollutants into the air from a specific and clearly discernable discharge point, such as a power plant. Additionally, prescribed fires help reduce the intensity of ensuing wildfires for several years, depending on the pre-burn condition of the burn unit (Brennan and Keeley 2015).

Smoke Sensitive Areas and Sensitive Receptors

The Regional Haze State Implementation Plan for Arizona defines 'sensitive receptors' as "population centers such as towns and villages, camp grounds and trails, hospitals, nursing homes, schools, roads, airports, mandatory Class I Federal areas, etc. where smoke and air pollutants can adversely affect public health, safety, and welfare" (State Implementation Plan, Appendix A-10 page 36). Several smoke sensitive areas lay within the airsheds of the areas proposed for treatment (Table 30). The list is not inclusive, and we recognize that there are a number of communities within, adjacent, or sometimes downwind of the project that are likely to have some impacts of smoke from Rim Country activities and are not listed. While these areas do not necessarily meet the official definition of smoke sensitive, we are aware of smoke-sensitive populations in airsheds that could be impacted by prescribed fire, and experience has shown that these areas need to be considered when planning and executing prescribed fires.

A 'Class I' is an area classification that requires the highest level of protection under the Clean Air Act of 1963. Projects which may potentially impact Class I areas must address efforts to minimize smoke impacts on visibility. Class I areas most likely to be impacted by activities in the Rim Country project area are Petrified Forest National Park, Mazatzal Wilderness, and Sierra Anchas Wilderness (Figure 52).

Table 30. Smoke sensitive areas and sensitive receptors

Area	Proximity to implementation area	Concerns
Verde Valley	Less than 10 miles downslope south and southwest of project area	Hospitals, schools, human habitation, young children, senior citizens,
The Navajo Reservation	Northeast and east of the project area	Hospital, schools, human habitation, young children, elders
Fort Apache Reservation	Adjacent to project area to the south and east	Hospital, schools, human habitation, young children, elders
The Hopi Reservation	Northeast and east of the project area	Hospital, schools, human habitation, young children, elders
Snowflake / Taylor	About 15 miles north of the project area	Human habitation, schools, young children, seniors
Tonto Basin /Roosevelt	About 10 miles south southwest of the project area	Human habitation, schools, young children, senior citizens
Show Low	Project area to the east and west of Show Low	Hospital, human habitation, schools, young children, seniors
Heber Overgaard	Project area is adjacent to town in multiple directions	Human habitation, young children, school, seniors
Strawberry / Pine	Project area is on all sides of the both towns	Human habitation, young children, school, seniors
Blue Ridge	Project area is on all sides of the developed areas	Human habitation, young children, seniors
Pinetop/Lakeside	Project area is on all sides of the project area	Human habitation, young children, school, seniors
Payson	Project area is on all sides of the project area	Hospital, schools, human habitation, young children, seniors

The national visibility goal of the Clean Air Act is, "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I areas in which impairment results from manmade air pollution." Wildfires are considered to be natural sources of visibility impairment, and generally outside state control or prevention.

No NAAQS are in non-attainment over the project area. On rare occasions, pollution from distant, large population centers in California affects the air quality in the area. Huge dust storms (haboobs) that occur in the Phoenix valley can produce large amounts fugitive dust that has also been known to affect air quality in Northern Arizona, but these events are generally limited to a few days a year.

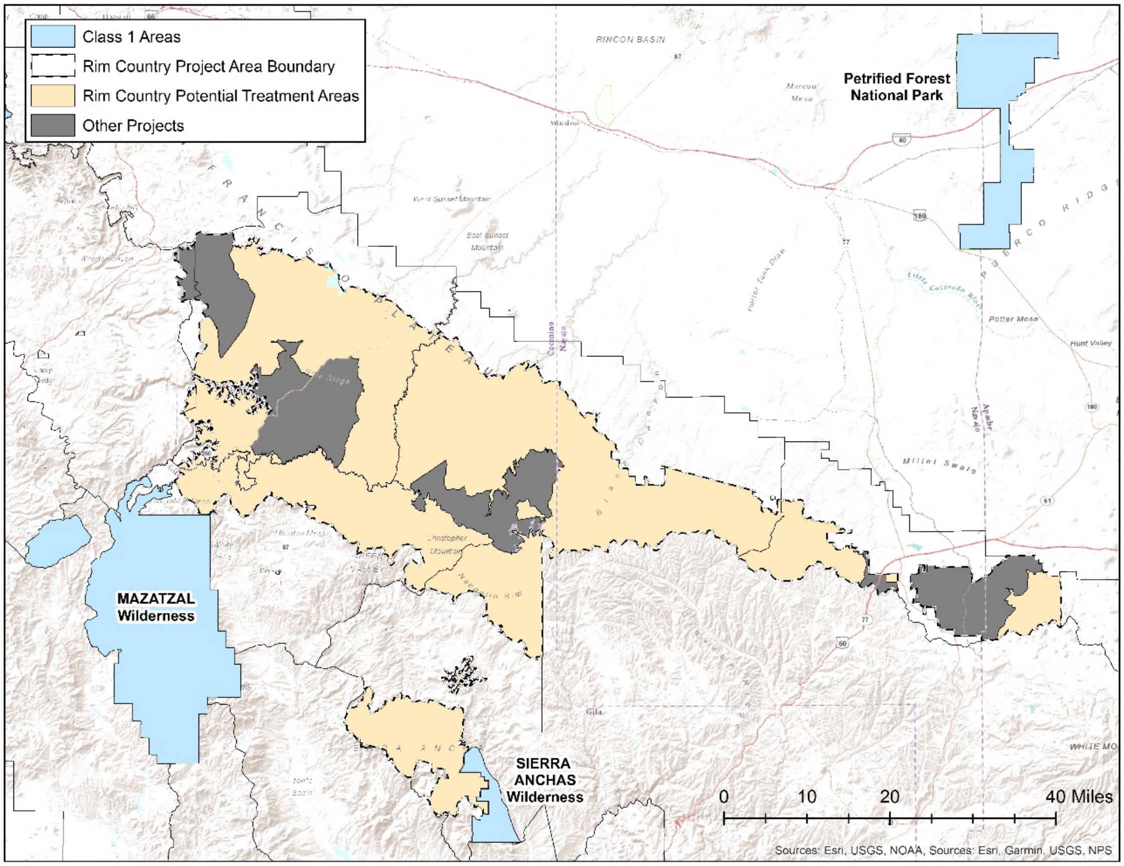


Figure 52. Class 1 areas with greatest potential to be impacted by Rim Country Smoke

Cumulative effects from prescribed fires and from wildfires that are not being actively suppressed in Federal, State, and Tribal lands are largely mitigated through implementation of the Enhanced Smoke Management Program in the Arizona Smoke Implementation Plan (SIP) by the Smoke Management Group. When the Federal land managers actively began prescribed burn programs in the 1970s, they became rapidly aware that a pro-active program for the coordination of prescribed burns would be vital to obtain and continue support of prescribed burning programs by ADEQ and the public. An interagency Smoke Management Group was developed in partnership with the State, and housed in the ADEQ offices in Phoenix. The personnel in the group are funded largely by Federal agencies, demonstrating the initiative of the agencies to, in some degree, self-regulate emissions production from prescribed burns, across Federal and State boundaries. This group assists land managers in not exceeding NAAQS or visibility thresholds

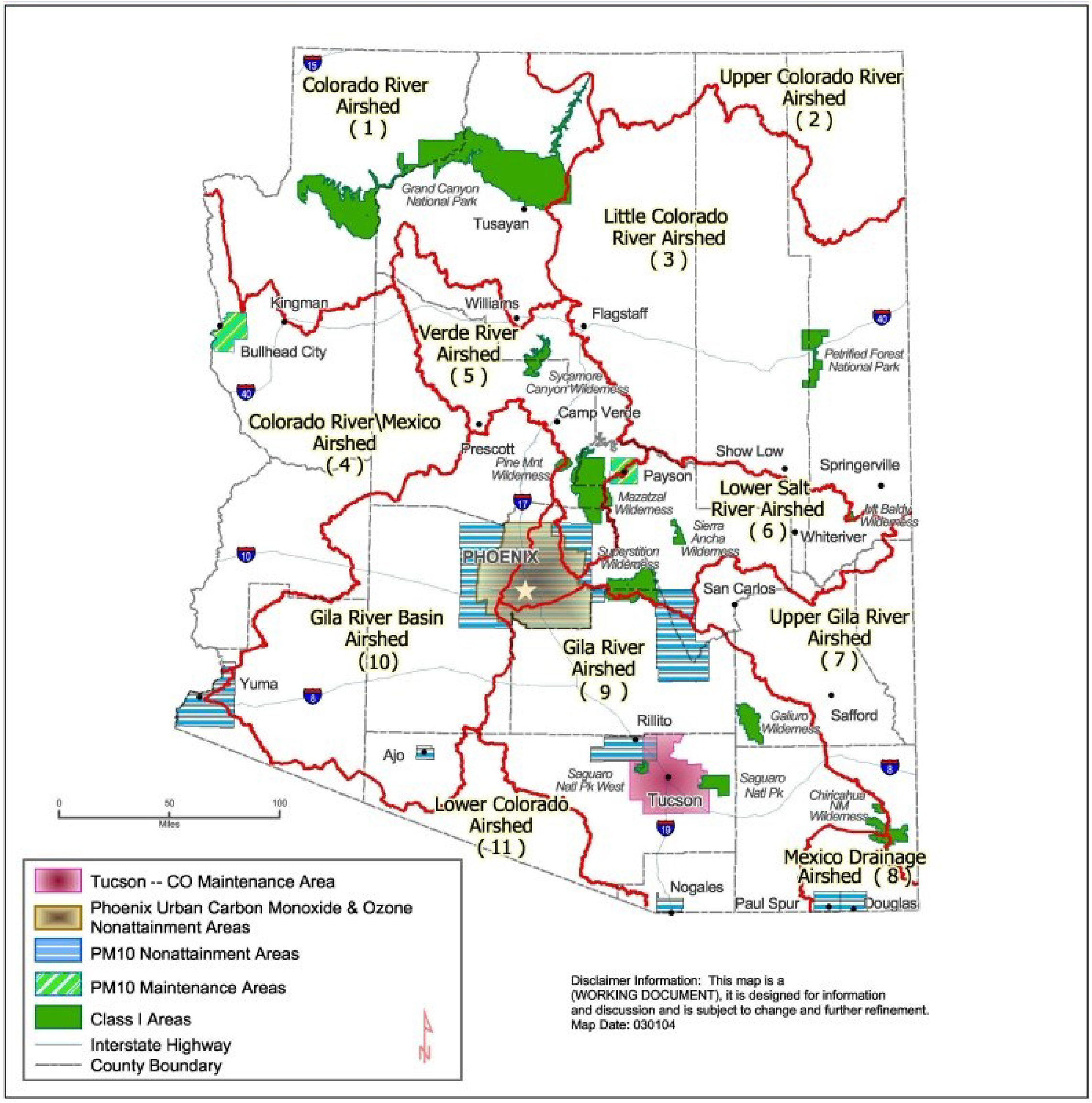


Figure 53. Arizona State airsheds

The Forest Service will continue to adhere to requirements in the Arizona State Implementation Plan to meet natural condition visibility goals. The most sensitive smoke receptor in the State of Arizona is the Verde Valley, which is easily impacted with nuisance smoke from the cumulative burning on the southern part of the KNF, the eastern side of the COF, and the Western side of the Prescott National Forest, as diurnal drainage of smoke from fires settles into this valley. Considerable coordination between Forests takes place when burns and wildfires that can affect the Verde Valley take place, facilitated by the interagency Smoke Management Group housed at ADEQ.

Public Influence

Public acceptance of smoke varies greatly from year to year. Acceptance of smoke from prescribed fires and beneficial 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 year when the threat of uncharacteristic fires is low, despite climatology in milder years being more favorable for achieving desired fire effects, especially in areas highly departed from reference conditions (Kleindiest 2012).

Ecological effects of smoke

Fire has historically played an important role in defining the character of ecosystems in Northern Arizona. The cover types in the Rim Country analysis that are targeted for restoration treatments are adapted to frequent fire, often area-wide fires (Cooper 1960; Covington *et al.* 1997b; Kaib 2001; Fulé *et al.* 2003; Huffman 2017), indicating an even more frequent smoke regime. Research in Northern Arizona has shown that the emergence of many species is enhanced by exposure to smoke from ponderosa pine needle litter (Abella 2006; Abella *et al.* 2007; Lata 2015).

Assumptions and Methodology

In the analysis of this resource the following assumptions were made:

All mechanical treatments were modeled to have occurred in 2019, and all areas proposed for burning were modeled to have burned in 2024 and again in 2034. In reality, treatments would be spread out over years. The specific timing of mechanical treatments would depend on the contract/contractor, road conditions, and numerous factors that are impossible to predict years in advance. Prescribed fire implementation depends on weather conditions, fuel conditions, other fires in the area, available resources, and multiple other variables that are impossible to predict weeks in advance. During the implementation period, untreated areas would be vulnerable to the effects as described in the Existing Condition and/or the Alternative 1 (no action), depending on the applicable time period. Modeling results presented do not include partial treatment, such as would be the case partway through implementation. Details on the treatments modeled can be found in the Silvicultural Specialist report' (Moore, this DEIS).

The prioritization of treatment areas will be a part of the implementation of Rim Country, though broad recommended methodology is presented here. Results were analyzed to compare the effectiveness of each action Alternative Against the "No-Action" Alternative (Alternative 1). Concepts that are necessary for a thorough understanding of this analysis are discussed when they are first presented. Additional information on modeling and concepts may be found in the Fire Ecology and Air Quality Specialist Report, the Silvicultural Specialist Report and the associated appendices.

The discussion of effects assumes that all BMPs, design features, and mitigations are applied during implementation. Effects discussions are based on modeled fire behavior, modeled emissions, and proposed treatments for which the methods and assumptions are detailed in this section and in the Fire Ecology and Air Quality Specialist Report and the Silviculture Specialists' Report (Moore, this DEIS).

Scales of analysis

The alternatives in this analysis are evaluated at multiple scales to ensure the expected effects are being considered in the appropriate context.

In order of decreasing size, with the largest first:

1. **Rim Country Project Area:** This includes the entire area analyzed for treatment, including comprehensive restoration, at 1,240,000 acres. It includes large areas on which the Rim Country analysis is not recommending treatments. (Figure 3)
2. **Hydrologic Unit Code (HUC):** Proposed treatments will be analyzed and evaluated at the 6th level HUC. In order to be included in this report, at least 30 percent of the watershed had to be

within the Rim Country Project Area, resulting in 80 watersheds being analyzed. The watersheds range in size from 7,176 acres to 39,135 acres, with a mean size of 18,465 acres. (Figure 54).

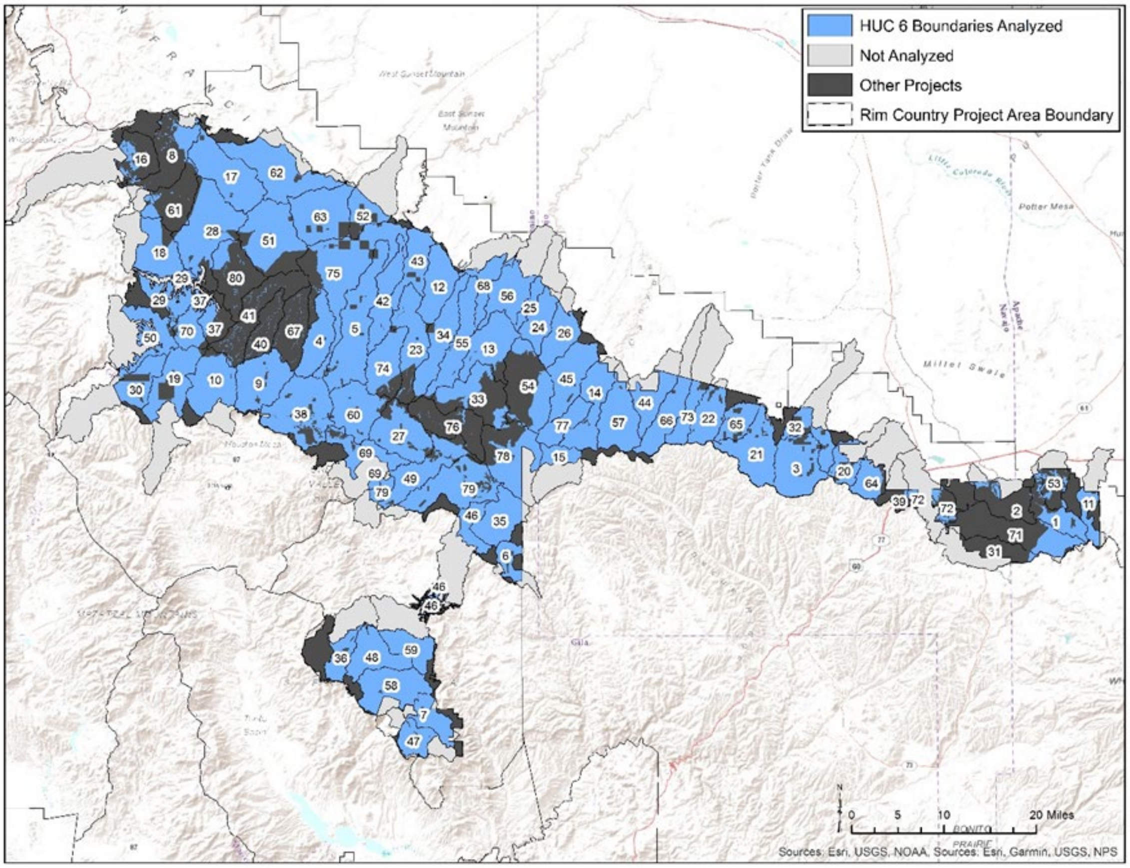


Figure 54. HUC 6 Boundaries. Dark gray areas are those areas within the project area that have current NEPA projects, and are not being fully re-analyzed in this report. Light gray areas are HUC 6 boundaries that fall outside the project area and were not analyzed in this report

Metrics & Measures

Throughout this analysis, there are references to 'undesirable fire behavior and effects'. Where it is legally and practically possible, 'desirable' fire behavior and effects align with reestablishing natural fire regimes, and that is the intent across the majority of the project area. Examples of where it is not possible to restore the natural fire regime include, but are not limited to, the following:

Example 1: Mexican Spotted Owl habitat: Where there are nest cores, in particular, there is a need, legally and biologically, to manage those areas for denser vegetation than may have existed there historically. That means that, in most cases, fire will need to be less frequent than it would have been historically, and there is a desire to prevent high severity fire in those areas.

Example 2: Proximity to infrastructure for certain vegetation types. Some of the ponderosa pine/evergreen oak and adjacent Chaparral/Madrean cover types historically would have had components of high severity fire as part of their natural fire regimes. Where these cover types occur on steep slopes above vulnerable assets, it may be necessary to manage these areas for lower severity fire.

The metrics used to evaluate the effectiveness of the alternatives in meeting the purpose and need of the project are described in detail below. A comparison of the outputs of these metrics between alternatives is displayed in Table 31.

Table 31. Brief description of the metrics used in this analysis

Metric	Application	Issue/s Addressed	Assets and Resources Addressed
Fire Type	Indicates potential fire behavior at all scales analyzed. Crown fire is one an indicator of high severity fire.	Landscape and habitat resilience to wildfires burning under extreme conditions, vulnerability of values	Fire Management, Wildland Urban Interface, Old Trees, Vegetation Cover Type, Watershed Response
Fire Hazard Index	See page 219 for details.	Landscape/habitat resilience to wildfires burning under extreme conditions, including both first and second order fire effects, and wildfire suppression difficulty.	Fire Management, Wildland Urban Interface, Vegetation Cover Type, Watershed Response
Total Surface fuel loading (Litter + Duff + Fine Woody Debris + Coarse Woody Debris)	Surface fuel loading is used to indicate potential for surface fire severity and intensity, particularly in areas where there may not be crown fire. It is also an indicator of potential emissions.	Potential for emissions and for high burn severity and high severity effects from both prescribed fire and wildfire from first and second order fire effects.	Old Trees, Vegetation Cover Type, Watershed Response, Air Quality
Emissions	National Ambient Air Quality Standards for six pollutants: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), Particle Pollution 2.5 (PM2.5), Particle Pollution 10 (PM10), and Sulfur Dioxide (SO_2) were modeled based on various treatment types, and discussed in context with each alternative.	Air quality concerns; particularly human health and visibility.	Air Quality

The effects of wildfire as quantified by the metrics and measures have direct implications for a variety of highly valued resources and assets. For this report, the resources and assets analyzed will include:

1. Fire management
3. Wildland Urban Interface
4. Old Trees
5. Vegetation Cover Type
6. Air Quality

Fire Modeling

The intent of the fire modeling in this analysis is to identify the areas at greatest risk of undesirable fire behavior and first and second order fire effects, and what the expected effects would be for each of the alternatives. Additional details for fire modeling can be found in the Fire Ecologist Specialist Report 2019.

One of the objectives of the Rim Country EIS is to reduce the likelihood of uncharacteristic wildfires, including large, high severity fires. Modeling fire behavior using conditions under which an uncharacteristic fire is known to have occurred allows for increased accuracy of post-treatment modeling results (McHugh, 2006). This analysis used the Rodeo/Chediski (RC) Fire, which was a large, complex fire that burned in 2002 on the Tonto and Apache-Sitgreaves National Forests, including about 100,000 acres within the Rim Country project area.

Data for modeling fire behavior is based on a landscape file with describes the fuel and topographic characteristics of an area, at a 30 square meter (0.22 acre) resolution. The landscape file was created using a combination of Landfire 2014 data (LF1.4.0), Lidar data, USFS stand data (Moore, this report) and satellite imagery (NAIP, USFS Resource Photography). Existing condition fuel models were assigned based on a combination of Landfire Existing Vegetation Type (EVT), canopy cover, canopy height and past disturbance. The predominant Landfire EVT was modified in order to match the FSVeg stand vegetation cover type, while non-burnable surfaces and riparian corridors were left unmodified regardless of stand vegetation cover type. Lidar data was used to create canopy cover and canopy height rasters. Mapped disturbances including mechanical treatments, prescribed fire and wildfire from 2008 – 2017 were used to further modify fuel model assignments.

Fire behavior for alternative future conditions used outputs from the Forest Vegetation Simulator Fire and Fuels Extension (Dixon 2003; Rebain 2016) to adjust data for modeling the effects of actions, or no actions, proposed in the alternatives. Post-treatment landscape files were modified from the existing conditions using the percent of change to canopy characteristics output from FVS-FFE. The resulting stand characteristics informed the assignation of post-treatment fuel models using the Landfire Total Fuel Change tool (LFTFC v0.160).

Fire Type

In ponderosa pine and most of its associated vegetative communities, the expected type of fire is a good indicator of the health and resilience of the ecosystem. Crown fire in ponderosa pine is lethal to the tree, therefore the amount and distribution of crown fire activity is an important indicator of the health of a frequent fire forest. Fire types include active crown fire, conditional crown fire, passive crown fire, and surface fire as described below.

Active Crown fire: A fire that advances from crown to crown in the tops of trees or shrubs (NWCG 2008). Active crown fires generally produce high severity effects and are considered 'stand replacing' because they top-kill, kill and/or consume most of the dominant overstory vegetation. Active crown fire is linked to surface fire, perpetuated by a combination of surface and canopy fuels.

Conditional Crown Fire: Conditional crown fire is a type of crown fire that moves though the crowns of trees, but is not linked to surface fire. Crown fire must initiate in an adjacent stand and spread through canopy fuels alone. Conditional crown fires burn in areas where canopy base heights are too high for crown fire to initiate within the stand, but there is sufficient horizontal continuity of canopy fuels to carry a crown fire if initiated. In the fire modeling used, Conditional Crown Fire was combined with Active Crown Fire.

Passive Crown Fire: Individual trees or groups of trees 'torch', as fire moves up into the canopy, ignited by the passing front of a surface fire. The fire climbs up ladder fuels (low branches, shrubs, or herbaceous vegetation that can produce flame lengths long enough to allow a fire to 'climb' into the crown of a tree) into the crown of a tree, igniting the crown ('torching' it), but does not spread very far into adjacent crowns (NWCG 2008).

Surface Fire: These are fires that burn in surface fuels only. Such fires consume surface fuels such as litter, duff, dead/down woody fuels, and herbaceous or shrubby fuels that are cured enough to be available fuel. Surface fire can be beneficial or detrimental in ponderosa pine, depending on the fuel loading, and the conditions under which the fire burns.

Fire type was evaluated at the Rim Country project area level and at the 6th level hydrologic unit code (HUC) and in order to facilitate an analysis of specific fire effects in different areas. Watershed impacts from fire increase with the proportion of the watershed burned at high severity (Cannon 2010; Neary 2011). Therefore, fire type is considered at all scales in those areas proposed for thinning and/or prescribed fire.

Fire Hazard Index (FHI)

Five datasets were used to identify areas of high probability for severe fire effects, extreme behavior and a complex fire management environment. These datasets are crown fire potential, fireline intensity, heat per unit area, slope, and soils with high erosion potential.

The FHI classified the landscape as shown in Table 32 below. The FHI was evaluated at the Rim Country project area level and at the 6th level hydrologic unit code (HUC) and in order to facilitate an analysis of specific fire effects in different areas. Resource impacts and fire management responses will change with the proportion of the watershed in high hazard classes. Therefore, FHI is considered at all scales in those areas proposed for thinning and/or prescribed fire.

Table 32. Fire Hazard Index scores used to identify the need for treatment for resources, values and assets

Rating	Comments
1 – very low	Conditions are such that expected fire behavior will have minimal negative impacts to resources and suppression efforts, where needed, are expected to be very effective
2 – low	From a fire perspective, areas where crown fire is expected will not pose a threat to soil stability. Areas of high erosion potential are not expected to burn with active crown fires or high intensity conditions. Use of ground resources for suppression efforts becomes increasingly difficult.
3 – Moderate	Either extreme fire behavior resulting in difficult to control fires, or moderate soil severity. Presence of steep highly erodible soils may coincide with crown fire and higher intensity fires. Control of wildfire by suppression efforts will be difficult.
4 – High	These areas have the highest expected levels of all the fire behavior metrics. Control of wildfire by suppression efforts will be difficult and complex.
5 – Very High	These areas have the highest expected levels of all the fire behavior metrics, as well as steep slopes and highly erodible soils, making them prone to adverse second order effects such as debris flows. Control of wildfire by suppression efforts will be difficult and complex.

Surface Fuel loadings

In this analysis, total surface fuel loading includes fine dead woody debris (FWD) ≤ 3 inches in diameter (FWD), dead coarse woody debris (CWD) > 3 inches in diameter, litter, and duff. FWD and litter contribute significantly to fire behavior as well as fire effects, while and CWD and duff are mostly of interest in regards to fire effects (both direct and indirect). All three forest plans provide specific direction on desired conditions for CWD, but are silent or do not quantify any other components of surface fuel loading. As such, in this analysis, CWD, FWD, litter, and duff were combined as “total surface fuel loading” in tons/acre, which is evaluated both qualitatively and quantitatively regarding potential fire effects. Recommended surface fuel loadings are estimates, based on the best available science and expert opinion (Ottmar 2015) on the interaction of surface fuel loading with fire behavior and fire effects

Fuel loadings were evaluated at the Rim Country project area level and the 6th level hydrologic unit code (HUC) and in order to facilitate an analysis of specific fire effects in different areas. Water, soil and wildlife impacts from wildfire are also related to surface fuel loadings. Additionally, fuel loadings have direct influence on wildfire emissions, and therefore will be discussed in those sections as well.

There are no desired conditions for total surface fuel loading, but 20 tons/acres is a reasonable recommendation for average maximum surface fuel loading for the area of this analysis (see related discussion in the Fire Ecologist Specialist Report 2019). Historic levels were estimated to be 5 - 20 tons/acre for CWD alone.

Emissions Modeling

Smoke/emissions were evaluated both qualitatively and quantitatively by modeled emission quantities in pounds/acre for the most common stand condition under different treatment and non-treatment scenarios using the First Order Fire Effects Model (FOFEM CITATION). Fuel loadings were calculated for a representative Ponderosa Pine stand using FVS. The resulting modeled emissions shows the relative differences that the same piece of ground would be expected to produce before, during and after treatments.

For a landscape analysis, changes in those fuel components which produce the greatest percentages of emissions when they burn were modeled, and mapped using Forest Vegetation Simulator (Moore, this report). The components include litter, duff, FWD and CWD>3 inches (Lutes et al. 2009), which were combined into a single total surface fuel loadings metric in tons per acre.

Environmental Consequences

Throughout this section, changes directly attributable to proposed actions, such as thinning or prescribed fire, are direct effects. These include changes to shading, canopy continuity, canopy base height, consumption of surface fuel, etc. Changes to the potential behavior and effects of future wildfires that result from the direct effects are considered indirect effects. Effects of proposed actions for stream restoration and roads are discussed separately from those of thinning and prescribed fire.

Alternative 1 – No Action

Direct and Indirect Effects

Under Alternative 1, there would be no changes to current management. Alternative 1 would not meet the purpose and need of this project because most of the ecosystems and natural resources within the treatment area would continue to degrade. The treatment area would not move towards desired conditions. This alternative would not reduce the risk to human lives nor would it result in safe, cost-effective fire management that would protect, maintain, and enhance National Forest System lands, adjacent lands, and lands protected by the Forest Service under cooperative agreements. As required by FSM 5100 (page 9).

The direct and indirect effects of Alternative 1 relate to the effects of the continued degradation of surface and canopy fuel conditions, and the effects of the continued interruption of the natural fire regimes. These include the potential for the direct effects of large, high-severity wildfires occurring within the project area. The indirect effects of such burns could also compromise water resources due to post-fire flooding and debris flows. Indirect effects could also include impacts to air quality downwind and downslope of fires. The most likely impacts to air quality being locations northeast of the project area, and in low areas, such as the Verde Valley, Snowflake, and Showlow.

Fire Type

Fires that did occur in the project area would be wildfires; some of which could be beneficial, and some could be catastrophic or detrimental, depending on environmental conditions at the time of the fire, and the condition of the forests at the time they burn. If historic patterns of burn severity were to continue, approximately 73 percent of the area burned in wildfires larger than 1,000 acres would burn with low severity effects that could be beneficial. However, given extreme weather conditions, there would be an increased potential for crown fire compared to the existing conditions. All crown fire types (both active and passive) can be expected across approximately 80 percent of the project area under extreme weather conditions (Figure 55), up from 73 percent in the existing conditions. Approximately 33 percent of the projected area has the potential to burn with active crown fire, up from 31 percent in the existing conditions.

Post wildfire watershed effects increase with the percentage of the watershed that burns at moderate to high severity (Cannon, 201; Neary 2011). Under Alternative 1, 47 watersheds are expected to burn with active crown fire under extreme weather conditions for over 30 percent of the watershed, resulting in high severity effects Figure 56). Thirteen watersheds are have over 50 percent of the watershed expected to burn with active crown fire. Watersheds 56 (Durfee Draw-Chevelon Canyon) and 7 (Reynolds Creek) have the highest proportion of potential for active crown fire (68 percent for both). If a wildfire were to burn within these watersheds, detrimental post wildfire effects would be expected.

Fire Hazard Index

The short term (< 20 years) effects of Alternative 1 would include an increased risk of undesirable wildfire behavior and effects. Wildfire behavior and effects could threaten lives, resources, and infrastructure. Forty percent of the project area is within the moderate to extreme FHI, which presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality, up from 37 percent in the existing conditions (Figure 58).

There are 25 watersheds with over 50 percent of the watershed in the moderate to very high FHI categories (need reference). Watershed 7 (Reynolds Creek, 80 percent) and 107 (Upper Spring Creek, 77 percent) have the highest proportion of FHI in the moderate to very high class. Large wildfires in these watersheds have a high potential to be difficult and dangerous to suppress, and have a high potential for adverse post fire effects.

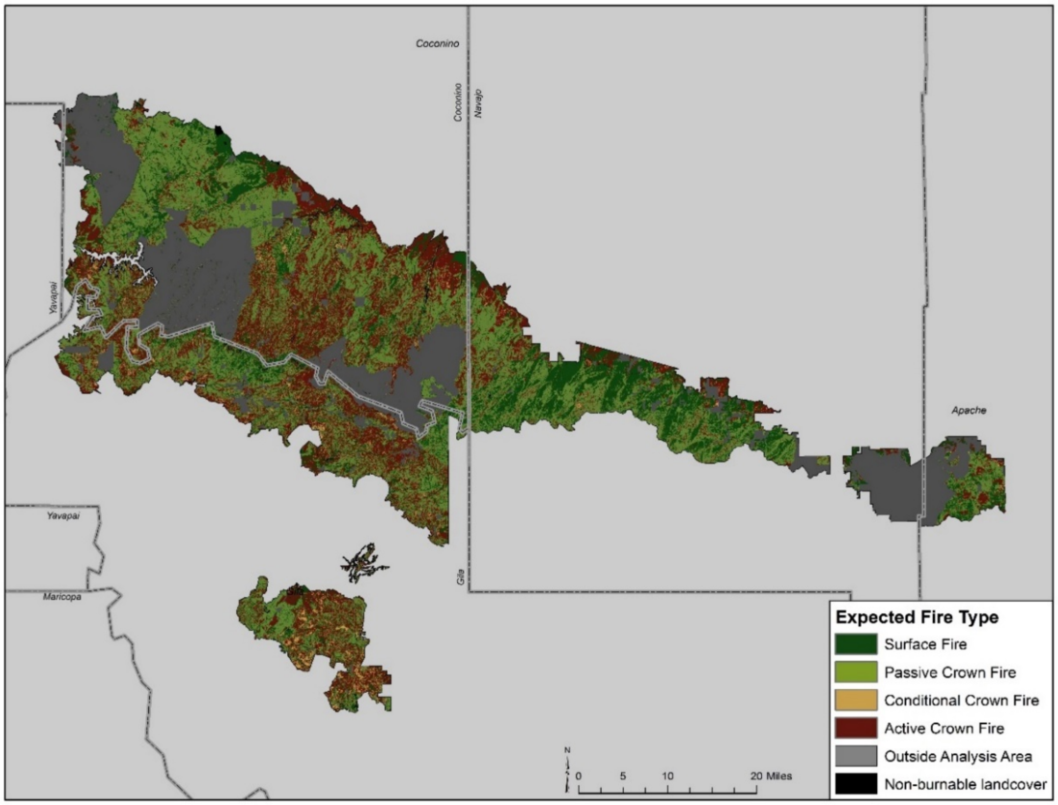


Figure 55. Expected Fire Type for Alternative 1, under modeled weather conditions

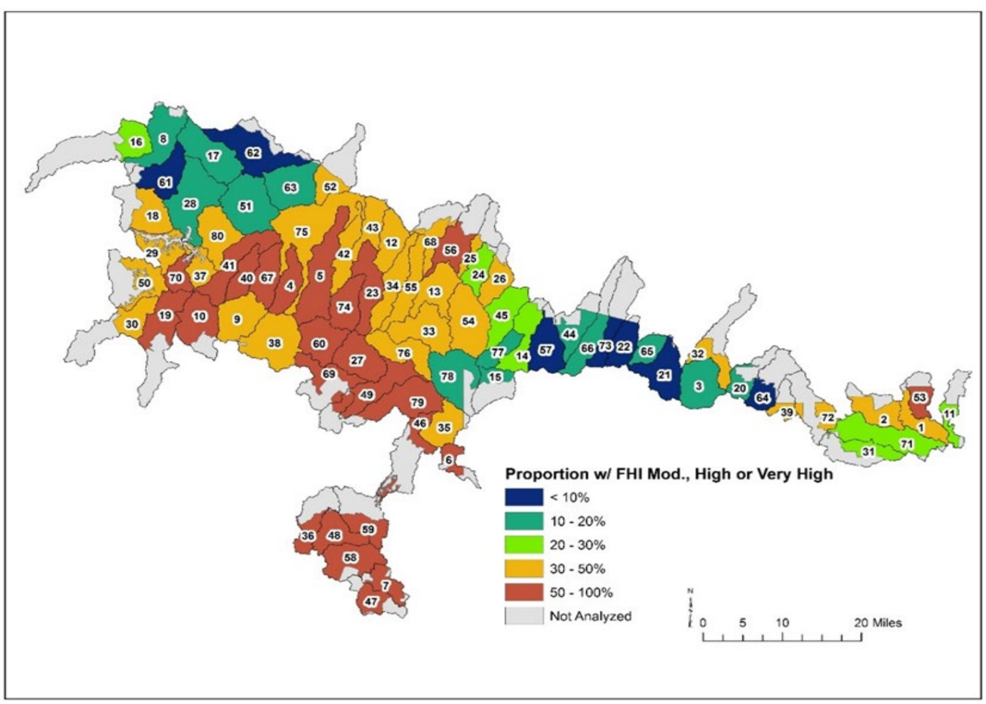


Figure 56. Proportion of each HUC6watershed with FHI in the moderate, high, or very high category for Alternative 1 under modeled fire weather

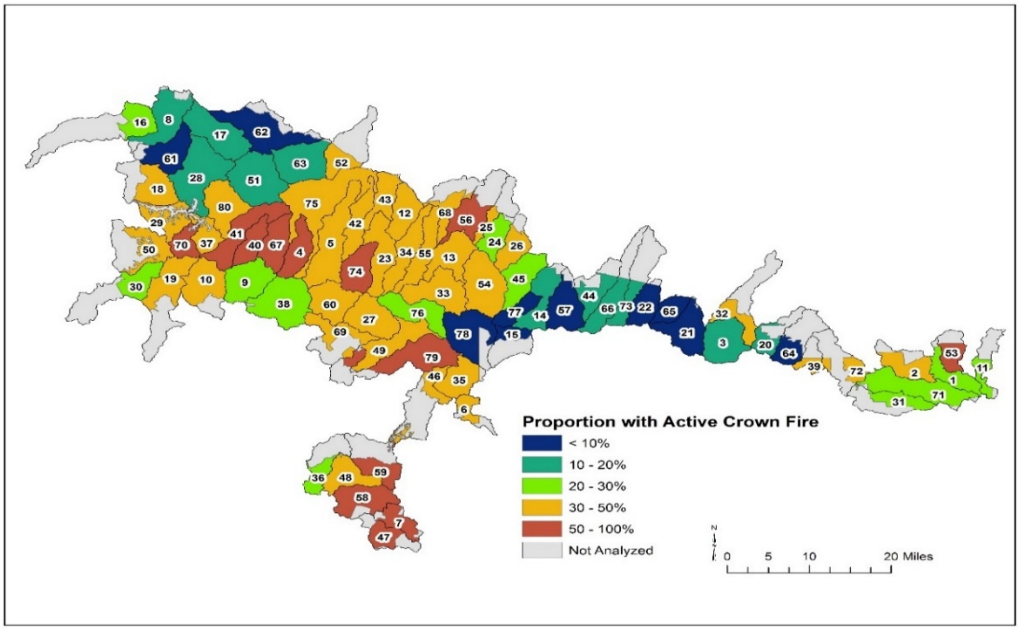


Figure 57. Alternative 1 proportion of HUC6 watersheds with expected Active Crown Fire, under modeled weather conditions

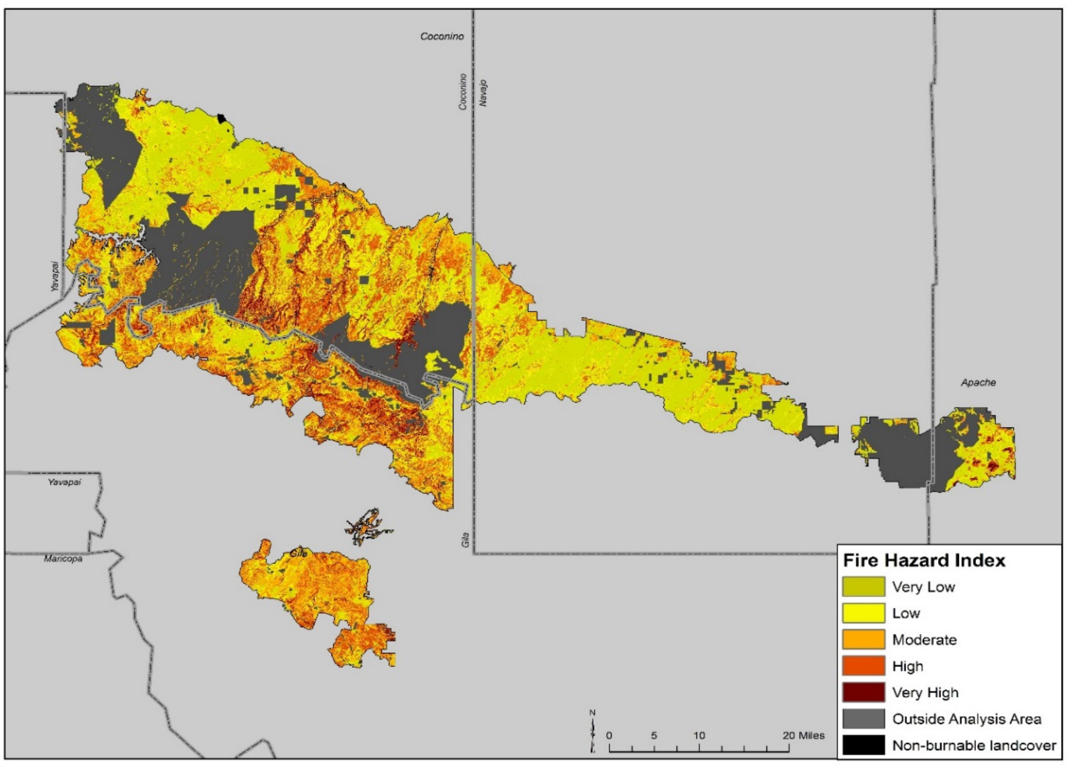


Figure 58. Fire hazard index for alternative 1, under modeled fire weather

WUI

Under the No Action Alternative, WUI areas across the treatment area would be threatened by the increasing extent of high severity of wildfires (Table 33). Active crown fire (CFA) and fire hazard index

(FHI) both increase. The potential for home and asset loss from crown fires, high intensity surface fires and ember lofting would continue to increase.

Table 33: WUI Measures and Metrics for Alternative 1

WUI CLASS	Total Acres	very Low - Low FHI	moderate FHI	high FHI	very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
High Value Rec Sites	375	45%	19%	18%	19%	83%	40%
Communication Sites	2074	63%	16%	18%	3%	79%	28%
Non FS Lands w/ structures	22638	63%	17%	18%	3%	73%	29%
Transmission Lines	4083	61%	17%	18%	4%	74%	33%
FS Buildings	1683	49%	14%	29%	9%	85%	43%

FS – Forest Service, WUI – Wildlife Urban-Interface

Vegetation Cover Types

In the long term (>20 years), tens of thousands of acres (the actual amount would be a subset of the 334,800 acres in the treatment area that would likely burn with high severity effects) would potentially be converted to non-forested systems as a result of high severity fire, while other acres of non-ponderosa pine would be increasingly encroached upon by pine, including aspen, grasslands, and oak. Aspen stands would continue to decline, and some stands would be likely to disappear. Woody species continue to encroach into grasslands and shrublands, and sprouting shrubby species would increasingly occupy understories in Ponderosa Pine Evergreen Oak. Table 34 shows the metrics for each vegetation cover type.

Table 34: Vegetation Cover Type Measures and Metrics for Alternative 1

Vegetation Cover type	Total Acres	very Low - Low FHI	moderate FHI	high FHI	very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
Ponderosa Pine	556284	75%	7%	16%	3%	81%	22%
PIPO Evergreen Oak	147989	36%	33%	26%	5%	85%	30%
Dry Mixed Conifer	49281	26%	17%	28%	29%	77%	54%
Wet Mixed Conifer	3130	29%	4%	26%	41%	74%	70%
Aspen	1438	95%	1%	3%	2%	6%	5%
Pinyon Juniper	135085	36%	33%	28%	3%	71%	67%
Madrean Pinyon Oak	23318	19%	33%	41%	7%	86%	80%

Vegetation Cover type	Total Acres	very Low - Low FHI	moderate FHI	high FHI	very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
Grasslands	18851	98%	2%	0%	0%	16%	3%
Riparian Areas	14567	70%	11%	13%	6%	48%	19%

Large and old trees

Under the No Action Alternative, large and old trees across the treatment area would be threatened by the increasing extent of high severity of wildfires (Swetnam 1990a; Covington and Moore 1994; Swetnam and Betancourt 1998; Westerling *et al.* 2016). In areas where a wildfire would be a first entry burn and there had been no prescribed fire or thinning, there would be a much greater potential for mortality than in treated areas. In this alternative, many old trees would be killed or damaged by wildfire, as well as those trees that die or decline slowly from the cumulative effects of fire and other stressors (Minard 2002).

Surface Fuel Loadings

Under the No Action Alternative, surface fuel loading would continue to accumulate. This would lead to high burn severity (fire effects to soil) as residence time increases with increasing surface fuel loading. Coarse Woody Debris (dead/down woody fuels greater than 3” in diameter) could be expected to switch from predominantly sound to predominantly rotten debris after about 15 years with no fire, with the highest CWD loading expected from 6 – 12 years after the last fire (Roccaforte *et al.* 2012). Desired conditions for total surface fuel loadings are less than 27 tons/ac in Ponderosa Pine vegetation types and less than 30 tons/ac in Dry Mixed Conifer. Under Alternative 1, 171,440 acres exceed 27 tons per acre, up from 105,528 acres in existing conditions. 123,077 acres of Ponderosa Pine and 25,967 acres of Dry Mixed Conifer vegetation types exceed recommended fuel loadings (Figure 59).

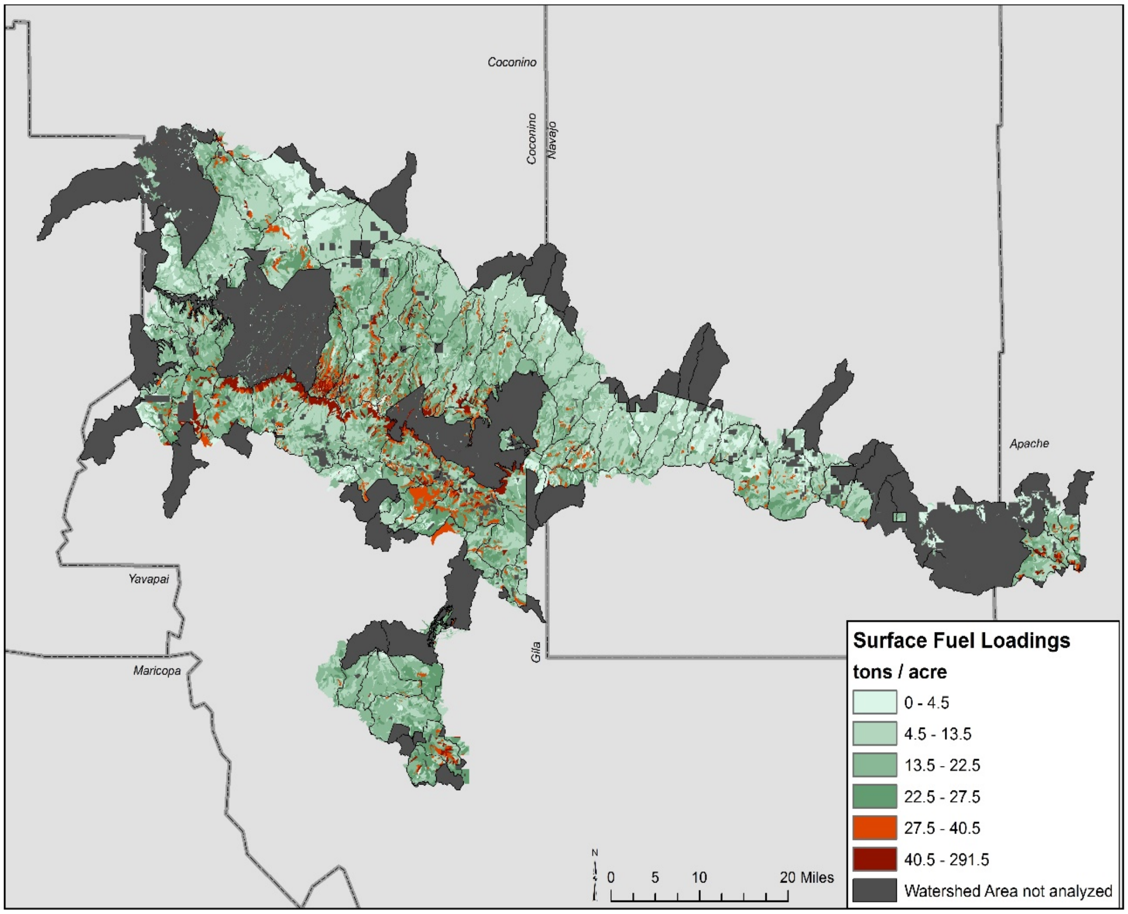


Figure 59. Surface fuel loads for alternative 1, under modeled fire weather

Emissions and Air Quality

In this alternative, smoke impacts generated from the proposed treatment area would only come from wildfires. The impacts would be infrequent (a few times a year); more severe when they occur; and the duration, location, and extent of area/s affected would be largely unpredictable. In the absence of wildfire, air quality would remain at current levels. In the short term, there would be no additional impacts on air quality from prescribed fires. Smoke impacts would be from wildfires. Wildfire smoke is less predictable, less frequent, and more concentrated than emissions from prescribed fires.

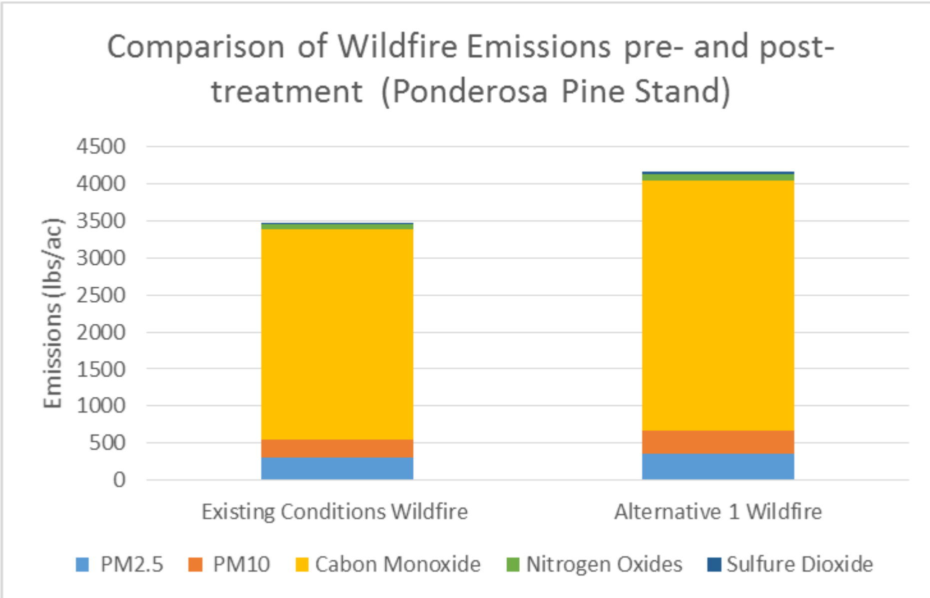


Figure 60. Emissions for alternative 1

If the current average annual acres burned by wildfire remained the same (27,426 acres), it is possible that much of the treatment area could burn with wildfire by 2065, and these fires would produce associated air quality impacts. Due to increased potential for crown fire and increased total surface fuel loadings, a wildfire burning under Alternative 1 conditions in 2029 would produce more emissions than one burning under current existing conditions (Figure 60). Wildfire would be the only source of emissions from the treatment area under this alternative. On a per acre basis, emissions increase approximately 17 percent, due to the increase in surface fuel loadings. This in combination with the expected increase in annual acres burned will lead to an increase in overall emissions from wildfires.

This alternative would not increase potential smoke impacts during the times of the year when smoke impacts are largely from prescribed fire (pile burning, broadcast burns, and jackpot burning), generally, mid/late fall, winter, and early spring.

The timing and type of smoke effects would change little initially, but as the likelihood of large fires increase so does the potential for air quality levels that exceed National Ambient Air Quality Standards (NAAQS), and nuisance smoke. The likelihood and degree of potential impacts from wildfire smoke would continue to increase as fuel loading increased, since much of the lingering smoke comes from duff, CWD, litter, stumps, and other fuels that can smolder. Watersheds 75 (East Clear Creek-Clear Creek) and 79 (Haigler Creek) have the greatest potential to produce emissions because of surface fuel loading. Under Alternative 1 all watershed increased in total surface fuel loadings, with watershed 58 (Upper Salome Creek) and 37 (Clover Creek) increasing the most (33 percent increase from existing conditions. Watershed 75 (East Clear Creek / Clear Creek) has the highest total surface fuel loadings and therefore has the potential to produce the most emissions should it burn (Figure 61). Watersheds 4 (Barbershop Creek) and 27 (Christopher Creek) have the most dense total surface fuel loading, both with an average of 24 tons/acre.

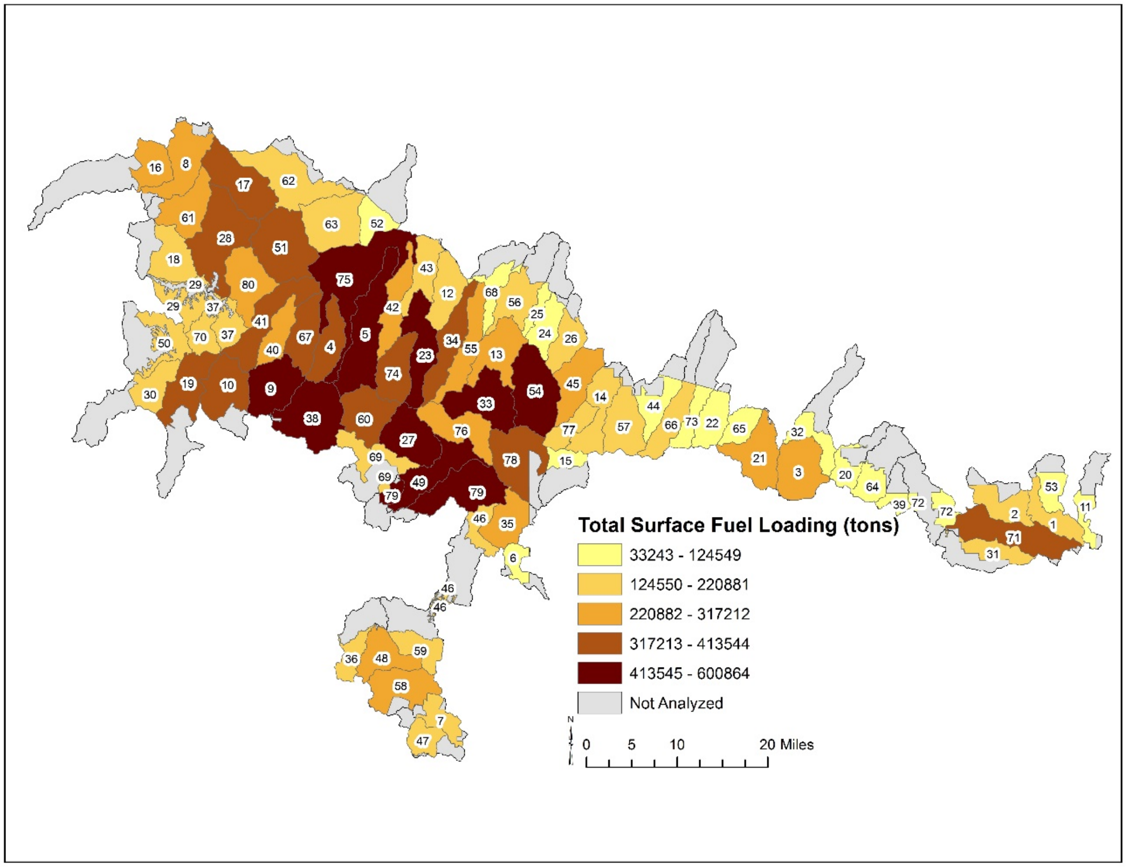


Figure 61. Total surface fuel loads in each HUC6 watershed alternative 1, as modeled using FVS

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources

As described above, with no treatment, high severity fire effects would become more widespread, and extreme fire behavior would become more common. In recent years, fires in the area have taken human lives, destroyed homes/property/infrastructure, and produced high severity effects across large areas not adapted to high severity fire including Rodeo/Chediski 2002 (469,000 acres), Wallow 2011 (538,000 acres), and Whitewater 2012 (~297,000 acres). There is broad consensus that such fires will continue to burn in this area if no action taken, though the specific extent and location of the negative effects could not be known until an incident occurs. First order effects would include (but are not limited to): chemical and physical changes to soil, high levels of mortality across ~27 percent or more of the burned area (assuming ~27 percent high severity), consumption and/or killing of the seed bank, consumption of organic material in soil, including flora and fauna, conversion of forested habitat to non-forested habitat. Second order fire effects would include (but are not limited to) erosion, flooding, debris flows, destroyed infrastructure, changes in visitation to the forest and the economies of local businesses that depend on visitors and natural resources, and degradation of water resources for wildlife, livestock, and humans. Some of these effects would last just a few days or weeks, some would take much longer. For example, topsoil is critical to healthy surface vegetation and would take centuries to recover though, with climate change, it is unknown exactly what the ecological trajectory would be. The loss of old growth and old trees would require decades to centuries to recover.

Effects Common to Both Action Alternatives

Activities that will effect fire and fuels include mechanical treatments and/or prescribed fire. While the number of acres of prescribed fire and mechanical treatments varies by Alternative, their effects, where implemented, will be the same.

Mechanical treatment alone has the potential to alter fire behavior primarily through a reduction of CBD, but it can also increase surface fuel loadings through the placement of slash on the ground (Carey and Schuman, 2003). Carey and Schumann (2003) further note that the use of mechanical thinning alone has a varied effect on modifying fire behavior, primarily because of the created slash. All of the thinning treatments proposed within this analysis are paired with prescribed burning, therefore, the effects will be a combination of thinning and burning. Various researchers have concluded that the combination of thinning and burning as the most effective way to alter fire behavior (Strom 2005; Graham et al. 2004; Peterson et al. 2005; Cram et al. 2006).

The effectiveness of using prescribed fire as a tool, alone or combined with mechanical treatment, to restore ponderosa pine to a healthier, more sustainable and resilient condition is well documented (Fulé et al. 2001b, Roccaforte et al. 2008, Strom and Fulé 2007, Fulé et al. 2012). Prescribed fire is used as a proxy for wildfires which allows for more control over where and when fire burns and often leads to lower overall severity and emissions.

Most of the effects of the natural role of fire could not be effectively replicated by means other than fire. These effects include nutrient recycling; seed scarification (by both heat and smoke); promotion of a mosaic of seedlings, shrubs, forbs, and grasses; regulating surface fuel loads, changes in soil moisture, changes to albedo, etc.. (Laughlin *et al.* 2008; Pyke *et al.* 2010; Laughlin *et al.* 2011). Over time, prudent use of prescribed burning, particularly when combined with mechanical thinning, would reduce the potential for damage from wildfires, as well as the costs associated with fire suppression (Jaworski 2014). Fire increases structural heterogeneity and diversity and promotes natural regeneration of ponderosa pine, providing favorable seedbeds and enhancing the growing environment for survival (Harrington and Sackett 1992).

The proposed treatments would create a mosaic of interspaces and groups (of ponderosa pine) of various sizes that would be maintained with fire. This mosaic is also a mosaic of crown fire potential, with some groups having potential for crown fire under some circumstances, with the surrounding interspaces causing crown fire to transition back to surface fire.

Post-treatment conditions for the action alternatives would include openings that would be managed to promote regeneration. Prescribed fire would be an important tool for creating receptive seedbeds for successful regeneration by consuming surface fuels, creating bare, mineral soil, allowing seeds better contact with soil. As seedlings and small saplings mature, fire and competition would thin trees, maintaining the desired trajectory for a fire-adapted landscape, so that an appropriate number of seedlings survive to maintain healthy forest conditions.

The longevity of the effects of a prescribed fire depends on the specific effect being evaluated; the condition of the burned area before a burn; the conditions under which it burned, and post-treatment conditions (such as precipitation). For example, a denser forest will accumulate litter faster than a more open forest; soil conditions and moisture affect the rate of decay; the germination and survival of seedlings depends on cone production and environmental conditions for the first 2-3 years.

In the long term, fire would help maintain a shifting, sustainable, resilient mosaic of groups, interspaces, and openings. Without regeneration openings, even with fire, the space occupied by incoming regeneration would begin to fill in the interspaces and, in the long run, as the seedlings mature, it would increase horizontal and vertical canopy continuity so that, if crown fire did initiate, there would be potential for larger areas of high severity effects.

Up to two prescribed fires would be implemented, on all acres proposed for burning year which may include pile burning months in advance of broadcast burns. Ideally, prescribed fires would occur on an average of every 10 years, depending on yearly fluctuations in climate/weather at different locations within the treatment area. Some areas will have had prescribed fire or wildfire within the last 10 – 15 years, so prescribed fires that are implemented would be maintenance burns (see below). Limitations (wildlife concerns, smoke, funding, resource availability, etc.) may make it difficult to attain an average of a 10 year fire return interval across the proposed treatment area. Burning some areas on a slightly longer return interval may be warranted to reduce smoke in sensitive receptors as mitigation for prescribed fires.

Direct and Indirect Effects

In the short term (<20 years), where treatments are implemented, the potential for undesirable fire behavior and effects would be reduced by breaking up the vertical and horizontal continuity of canopy fuels, decreasing excessive surface fuel loads of litter and duff (direct effects). It would be expected that the growth of light, flashy fuels would be stimulated by post-treatment conditions (second order effects). Wildfire behavior would benefit the ecosystems in which it burned, and would not threaten lives, resources, or infrastructure, except where they are adjacent to, or near areas (such as MSO habitat or Wet Mixed Conifer) that were not treated as intensively as the rest of the treatment area at this time. Air quality impacts (indirect effects) could increase some as prescribed fires are implemented.

In the long term (>20 years), potential for undesirable fire behavior, as assessed by changes to surface and canopy fuels, would remain lower than existing condition for about 37 percent of the Rim Country area proposed for treatment. Potential for undesirable fire effects, as assessed by changes to canopy and surface fuels, would remain lower than existing condition for about 31 percent of the ponderosa pine in the treatment area. Impacts to air quality as a result of fire related pollutants emitted as a result of prescribed fire could decrease some as the majority of the treatment area would be in maintenance burn mode, producing fewer emissions per acre. However, since there would be more acres burned, the number of days of air quality impacts could increase.

Thinning, whether or not slash was removed from the site, would give managers more control of the amount and timing of emissions. As thinning and first-entry burns are completed, burn windows would expand for larger areas so more burning could occur when ventilation was good. Fewer and healthier trees, as a result of thinning and would be more fire resistant, and understory and surface vegetation would become established. With lower surface fuel loading, and canopy fuels adapted to fire, burn windows would be broader than for initial entry burns. Decision space for managing unplanned ignitions would expand as Rim Country (and other projects) are implemented.

Fire Type

Decreasing the horizontal and vertical continuity of canopy fuels is a direct effect of the proposed treatments that would allow sunlight to reach the surface, increasing surface temperatures, and decreasing dead fuel moisture content at the surface. This, combined with increased surface winds with fewer trees blocking the wind, could increase surface fire intensity, flame length, and rate of spread even if surface fuels were the same before and after thinning (Omi and Martinson 2004, Scott 2003). Therefore, canopy fuel treatments reduce the potential for crown fire (indirect effect) at the expense of slightly increased surface fire behavior (fireline intensity, flame length, and rate of spread). However, critical levels of fire behavior (limits of manual or mechanical control) are less likely to be reached in stands treated to withstand crown fires, as all crown fires are uncontrollable. Although surface intensity may be increased after treatment, a fire that remains on the surface beneath a timber stand is generally more controllable (Scott 2003). After the first prescribed fire, surface fuels would be lower so, even with the changes described above, the potential fire behavior and effects would be improved following the treatments under Alternatives 2 & 3.

Fire Hazard Index

Some components of the fire hazard index are fixed and not susceptible to changes due to proposed treatments. These components include slope and soil erodibility. While these components are necessary for determining potential fire behavior and/or post fire effects, treatments will not result in changes to these parts. The rest of the components, which relate more directly to fire behavior, will be influenced by proposed treatments in manors consistent with those discussed above in the Fire Type section and below in the Surface Fuels section.

Surface fuels

Mechanical thinning alone can contribute significantly to decreasing the potential for crown fire by breaking up vertical and horizontal canopy fuel continuity, but does little, in the long run, to decrease surface fuel loading. Initial thinning impacts may include temporary fire 'breaks' where there are skid trails, or other surface disturbances, but surface fuels that are not removed from the treatment area remain a potential source of heat and emissions. Effects may be spottier but, where fuels have been pushed into piles or furrows (intentionally or otherwise), they may smolder for days or weeks.

Litter, Duff, and CWD greater than 3" diameter contribute more than other fuels to emissions. Mechanical thinning alone can contribute significantly to decreasing the potential for crown fire by breaking up vertical and horizontal canopy fuel continuity, but does not decrease surface fuel loading (Fulé et al. 2012). Initial thinning impacts may include temporary fire 'breaks' where there are skid trails, or other surface disturbance, but surface fuels are generally not removed from the treatment area, and remain a potential source of heat and emissions. Surface effects may be spottier following thinning because residual fuels often include jackpots or small piles. Where fuels have been pushed into piles or furrows, by design or happenstance, they may smolder for a long time.

A direct effect of prescribed fires would be the consumption of some CWD and, although more is often produced as an indirect effect of the burn it may be of a different stage of decay that does not fill the same ecological niche. Surface fuel loading can be managed with fire and felling techniques to increase or decrease woody debris in different size classes. A direct effect of Alternatives 2 and 3 could be that some areas would be deficit in CWD for a few years following treatment but, given the trend shown, it would only be a few years before it met desired conditions again and, with maintenance burning, it should be possible to maintain desired levels.

CWD could be expected to switch from predominantly sound to predominantly rotten debris after about 15 years with no fire, with the highest CWD loading expected from 6 – 12 years after the last fire (Roccaforte *et al.* 2012).

Large/old trees

Ponderosa pine (*Pinus ponderosa* Dougl. ex P. & C. Laws) stands with late-seral features are found infrequently, owing to past management activities throughout western North America. Thus, management objectives often focus on maintaining existing late-seral stands. Observations over a 65 year period of stands with no past history of harvest showed substantial ingrowth in the smaller diameter classes and elevated rates of mortality among the largest mature trees in the stand. Adjacent stands, with combinations of thinning and prescribed fire, had far fewer high-risk mature trees and generally lower rates of mortality after treatment. Forecasts using individual-tree diameter growth and mortality models suggest that observed declines in these stands with remaining old trees and a dense understory will continue in the absence of any treatment.

Where site specific mitigation is needed to limit damage or mortality to large or old trees, it is best accomplished by reducing accumulations of fuels within the dripline and in the immediate vicinity of the trees. These fuels may include litter, duff, accumulations of woody fuels, ladder fuels, or any fuel that could produce sufficient heat to lethally damage a tree, whether by high or low intensity fire. This can be accomplished manually, mechanically, or though fire treatments. Potential measures include implementing prescription parameters, ignition techniques, raking, wetting, leaf blowing, thinning, or otherwise mitigating fire impacts to the degree necessary to meet burn objectives.

Throughout the life of this project, it is likely that some large and/or old trees would be damaged or killed by prescribed fire. It would not be possible to mitigate every large and/or old tree over 40,000 to 60,000 acres of prescribed fire units each year. Data collected from restoration treatments in the White Mountains indicates that mortality of pre-settlement trees increased with thin/burn, or burn only treatments over controls, although those that survived grew significantly faster than those in untreated stands. Managers will have to consider tradeoffs between treatment options, and the increasing likelihood of the trees burning in wildfires under conditions that would be more extreme than conditions under which a prescribed fire would be conducted.

Mechanical treatments and prescribed fire would be implemented to help sustain large/old trees across the landscape, and make them more resistant and resilient to natural disturbances such as fire. Throughout the life of this project, it is likely that some large and/or old trees may be damaged or killed by prescribed fire, by direct and/or indirect effects, despite mitigation measures. However, under both alternatives thinning and prescribed fire would decrease potential fire effects in the vicinity of most old and/or large trees, decreasing the likelihood of lethal damage in the event of a wildfire.

Mitigation measures are unpredictable, and site specific (Kolb et al. 2007, Hood 2007), and some can have negative effects of their own. Raking, for example, can remove fine, live roots in the surface organic layers, which may compound the effects of additional shallow roots being damaged by fire, though it is unlikely to actually kill the tree (Progar *et al.* 2017). Low intensity fire that causes little crown scorch can stimulate resin production in old trees that may attract bark beetles, increasing tree mortality. Mitigation measures implemented a year or more before a burn, such as thinning or raking, may improve the health of the tree, improving its response to fire.

Air Quality and Smoke

All acres are not equal when it comes to emissions. Open stands support surface fire over crown fire under most conditions, and surface fire produces fewer particulates than crown fire. Stands that have burned more recently and more frequently also produce lower emissions. Figure 62 shows differences in emissions from wildfire or prescribed fires that burn at different stages in burn only and mechanical plus burn treatment cycles.

The management action that has the greatest potential effect on air quality is prescribed burning. All prescribed fires are expected to achieve the desired conditions for air quality under the action alternatives, and hence, Air Quality is not expected to be a primary driver in selecting one alternative over another.

Some comparison between alternatives can be made by looking at the indirect effects of management activities that reduce the likelihood of active crown fire and heavy surface fuel loading. Active crown fire and heavy surface fuel loading produce large quantities of emissions that may be heavily concentrated. The alternatives that best alter stand structure to promote surface fire over active crown fire and decrease surface fuel loading would have the least negative environmental consequences to Air Quality, and are the focus of comparison between alternatives regarding Air Quality in this report.

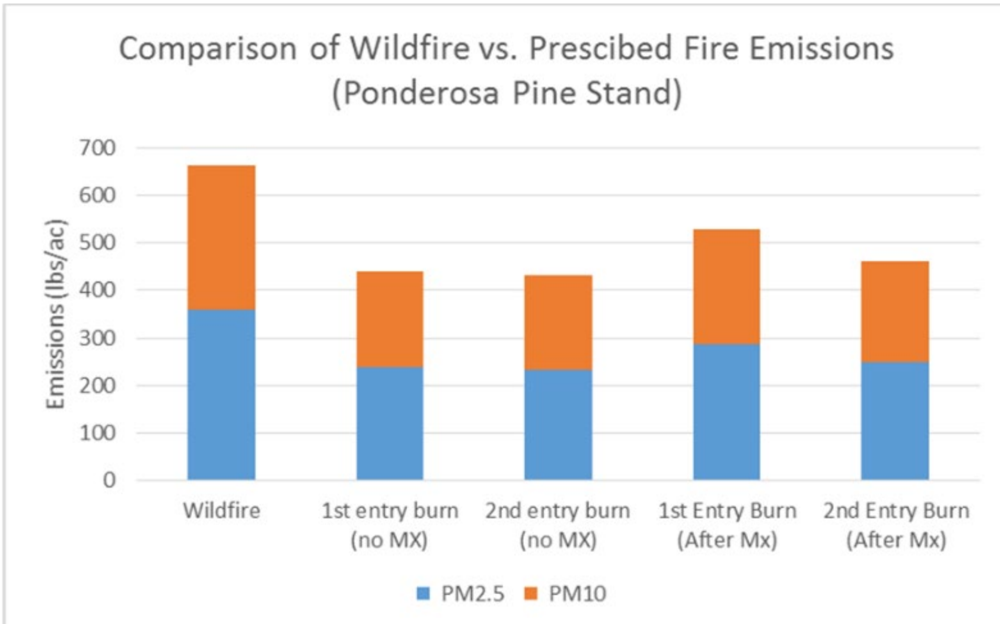


Figure 62. PM 2.5 and PM10 emissions from wildfires vs. prescribed fire at different stages of treatments

Up to two prescribed fires would be implemented, which may include pile burning months in advance of broadcast burns. Ideally, prescribed fires would occur on an average of every 10 years, depending on yearly fluctuations in climate/weather at different locations within the treatment area. Some areas will have had prescribed fire or wildfire within the last 10 – 15 years, so prescribed fires that are implemented would be maintenance burns. Limitations (wildlife concerns, smoke, funding, resource availability, etc.) may make it difficult to attain an average of a 10 year fire return interval across the proposed treatment area. Burning some areas on a slightly longer return interval may be acceptable and/or may specifically be target to reduce smoke in sensitive receptors as mitigation for prescribed fires.

The combination of prescribed fire and mechanical thinning is the most effective means of limiting emissions from wildland fires by reducing and breaking up fuel continuity. Mechanical treatments proposed by Rim Country would reduce fuels by combinations of cutting and burning. In some cases, thinning would be implemented prior to prescribed burning, allowing higher intensity fire to be used where appropriate, and effectively minimizing potential wildfire emissions by removing some canopy fuels. Disturbance of surface fuels may provide temporary fuel breaks by re-arranging surface fuels where there are skid trails, tire tracks, and other surface disturbances which break up surface fuel continuity while slightly increasing the amount.

In other areas, prescribed fire may precede thinning. This may be appropriate if an area would not be thinned for several years in order to reduce flammability in the interim by beginning the process of reducing surface fuel loads, increasing canopy base height, and decreasing canopy bulk density. It may also occur if there is an opportunity to expand an adjacent burn unit to include part of the treatment area to increase efficiency. It may also facilitate timelier implementation of prescribed fires if there is no need to wait a year or two for the mechanical treatments to be completed. In some cases, it may be preferable to use fire as a thinning agent when the site is too steep or remote to access with mechanical methods.

Air quality provides an example of short- and long-term trade-offs in implementing restoration across large areas. There is a risk of short-term human health impacts from prescribed fire. The emissions from prescribed fires, as opposed to wildfires, can be managed by carefully distributing (prescribed) fire over time and space, as well as under appropriated weather conditions (Cohesive Strategy 2002, page 39). In the long term, once an area has been burned once, there is less fuel and, thus, lower emission potential. The combination of lower fuel loads and larger burn units would allow more acres to be burned without exceeding NAAQS.

In the short term, as '1st entry' burns are implemented, impacts would increase noticeably. Acres with high fuel loading would be burned, in a first step toward restoring the natural fire regime. In the long term, the same acres would produce less smoke, along with maintaining an ecosystem that is resilient to fire, and benefits from it.

Air quality impacts can be predicted from prescribed fire, and the public notified of when and where to expect impacts in advance of a burn. Wildfires are less predictable and, though general patterns of smoke movement on the landscape are known, there is much less surety of where and when there would be impacts.

During the day, when units are ignited, smoke would be expected to travel on prevailing winds, away from sensitive receptors, and dissipate. Most smoke would dissipate, but some may surface. Short-term nighttime nuisance smoke could settle down the drainages into the towns below, particularly during early morning hours. Nighttime smoke would be expected to reside in low areas down slope from the burn units, because night time winds are generally calm. Daytime smoke would be expected to dissipate mostly downwind from the burn unit. Burn plans written for implementation of the proposed prescribed fires would include modeling to determine the most appropriate conditions under which to burn in order to minimize smoke impacts.

Under Alternative 2, air quality impacts would be most likely to those portions of the Little Colorado River Airshed east and northeast of Flagstaff; the Colorado River Airshed north of Williams and including all of the treatment area in RU6; and the Verde River Airshed. There is a small chance that there could be some impact to the northern portions of the Lower Salt River Airshed.

The difference in emissions between the treatments stays roughly the same, with no statistical difference and can generally be attributed the initial difference in fuel loading. The first prescribed fire following a mechanical treatment produced a little over 500 pounds/acre of emissions. The first prescribed fire without thinning produced a little over 400 pounds/acre of emissions. Since stands receiving mechanical treatment prior to prescribed fire start out with more surface fuel than those that are not mechanically treated prior to burning, additional emissions are produced.

Effects Unique to Each Alternatives

Alternative 2 – Modified Proposed Action

Alternative 2 proposes to conduct about 889,344 acres of mechanical and prescribed fire treatments and an additional 63,788 acres of prescribed fire only treatments over about 10 years or until objectives are met. On average, 88,934 acres of vegetation would be mechanically treated annually. On average, 95,313 acres of prescribed fire would be implemented annually across the Forests (within the treatment area). Up to two prescribed fires would be conducted on all acres proposed for burning over the 10-year period.

When analyzed at the scale of the treatment area, Alternative 2 would meet the purpose and need by moving the project area towards the desired condition of having potential for less than 10 percent active crown fire under extreme weather conditions, lessening post fire detrimental effects and creating a safer and more effective firefighting environment.

This alternative would meet direction in the Forest Service Manual 5100 (page 9) which includes direction on USFS use of prescribed fire to meet land and resource management goals and objectives. Objectives of fire management on lands managed by the USFS include:

> Forest Service fire management activities shall always put human life as the single, overriding priority. The proposed actions of the Rim Country fully support incorporation of the highest standards for firefighter and public safety and are expected to improve and enhance the safety of the public as it relates to wildland fire.
>
> Forest Service fire management activities should result in safe, cost-effective fire management programs that protect, maintain, and enhance National Forest System lands, adjacent lands, and lands protected by the Forest Service under cooperative agreement. Rim Country proposes to achieve restoration by restoring ecosystems within the treated area to a condition so that fire, when it occurs, would be beneficial to the ecosystems in which it burns without threatening lives, property, or resources. This would be achieved by fully integrating local industry, mechanical and fire prescriptive treatments, and providing for sustainable supplies of goods, services, and social values though implementation of appropriate fire management activities.

Direct and Indirect Effects

From a fire ecology perspective, direct and indirect effects of Alternative 2 relate primarily to treatments that include mechanical thinning, prescribed fire, or both to meet the purpose and need of the project.

Changes to potential fire behavior are the indirect effects of changes to fuel loading and structure. A direct effect of implementing Alternative 2, would be changes to the horizontal and vertical continuity of canopy fuels. As that continuity is broken up, an indirect effect would be decreased potential for crown fire.

Thinning, whether or not slash was removed from the site, would give managers more control of the amount and timing of emissions. As thinning and first-entry burns were completed, burn windows would expand for larger areas so more burning could occur when ventilation was good. Trees would be more fire resistant, and understory and surface vegetation would become established. With lower surface fuel loading and canopy fuels adapted to fire, burn windows would be broader than for initial entry burns. Decision space for managing unplanned ignitions would expand as Rim Country is implemented.

Fire Type

Once fully implemented, Alternative 2 is expected to reduce the potential for active and conditional crown fire to within desired conditions for all vegetation cover types (see Table 36 below). Over the rim country project area, 12 percent of the area burned under extreme weather conditions would be expected to be active or conditional crown fire, down from 31 percent given existing conditions (Figure 63). Passive crown fire increases slightly (57 percent up from 47 percent EC) under extreme conditions, due to the desired clumpy canopy characteristics of the mechanical treatments. Under less extreme wind conditions (5 MPH instead of 20 MPH), the majority of the landscape (95 percent) is expected to burn as a surface fire, and only 43,396 acres are expected to burn with passive crown fire, and 270 acres with active or conditional crown fire.

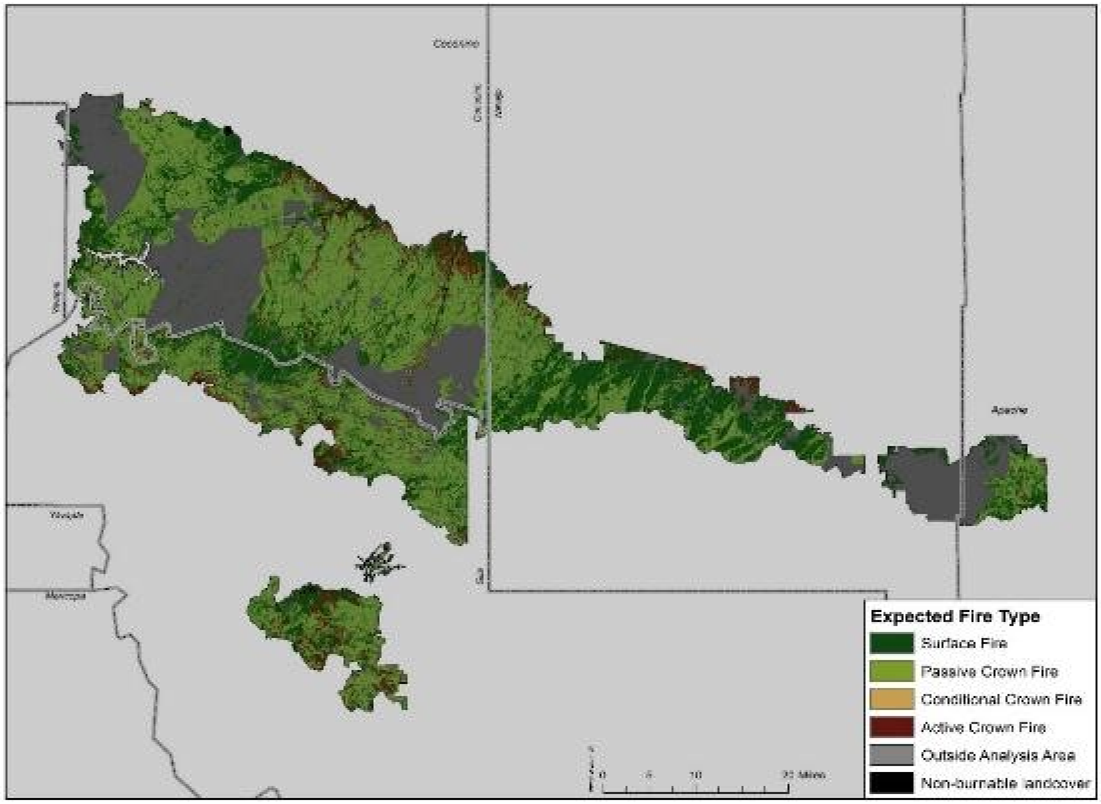


Figure 63. Expected Fire Type for Alternative 2, under modeled weather conditions

Post wildfire watershed effects increase with the percent of the watershed burns with moderate to high severity fire (Cannon 2010; Neary 2011). Under Alternative 2, 9 watersheds are expected to burn with active crown fire under extreme weather conditions for over 30 percent of the watershed, which would result in moderate to high severity effects (Figure 64). Three watersheds are have over 50 percent of the watershed expected to burn with active crown fire. Watersheds 67 (Bear Canyon) and 40 (Miller Canyon) have the highest proportion of potential for active crown fire (55 percent for both). If a wildfire were to burn within these watersheds, detrimental post wildfire effects, such as debris flows, would be expected.

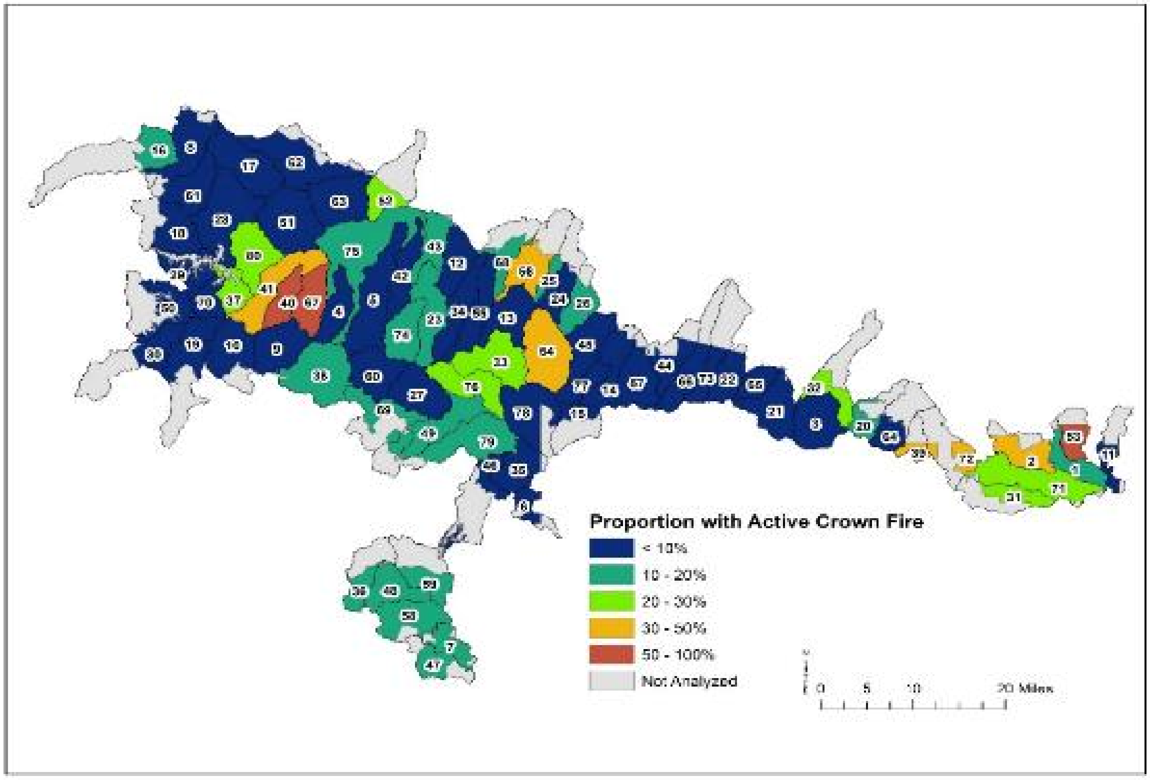


Figure 64: Proportion of each HUC6 watershed with Active Crown Fire for Alternative 2, under modeled weather conditions

Fire Hazard Index

Alternative 2 would decrease the risk of undesirable wildfire behavior and effects that could threaten lives, resources, and infrastructure. After implementation, the fire hazard index decreases resulting in 15 percent of the project area is within the moderate to extreme FHI, down from 37 percent in the existing conditions (Figure 65). The areas of moderate to extreme FHI presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality.

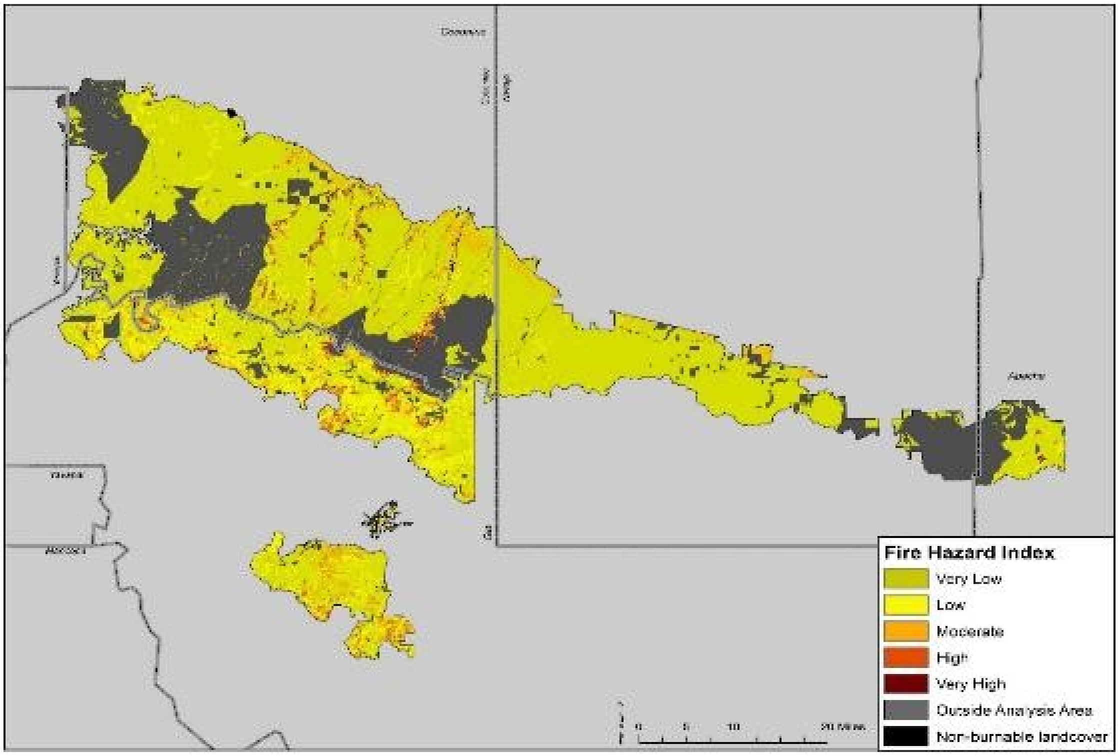


Figure 65: Fire Hazard Index for Alternative 2, under modeled weather conditions

There are 3 watersheds with over 50 percent of the watershed in the moderate to extreme FHI categories (Figure 66). Watershed 40 (Miller Canyon, 61 percent) and 67 (Bear Canyon, 65 percent) have the highest proportion of FHI in the moderate to very high class. Large wildfires in these watersheds would still have a high potential to be difficult and dangerous to suppress, and have a high potential for adverse post fire effects.

Surface Fuels loadings

Under the Alternative 2, surface fuel loading would initially increase with mechanical treatment. As first and second entry prescribed burns are implemented, these fuel loadings would decrease in most areas except those proposed for MSO treatments, which are designed to maintain a higher level of fuel loading, especially Coarse Woody Debris (dead/down woody fuels greater than 3" in diameter).

Desired conditions for total surface fuel loadings are less than 27 tons/ac in Ponderosa Pine vegetation types and less than 30 tons/ac in Dry Mixed Conifer. Figure 67 highlights those areas where surface fuel loading is expected to exceed desired conditions under Alternative 2.

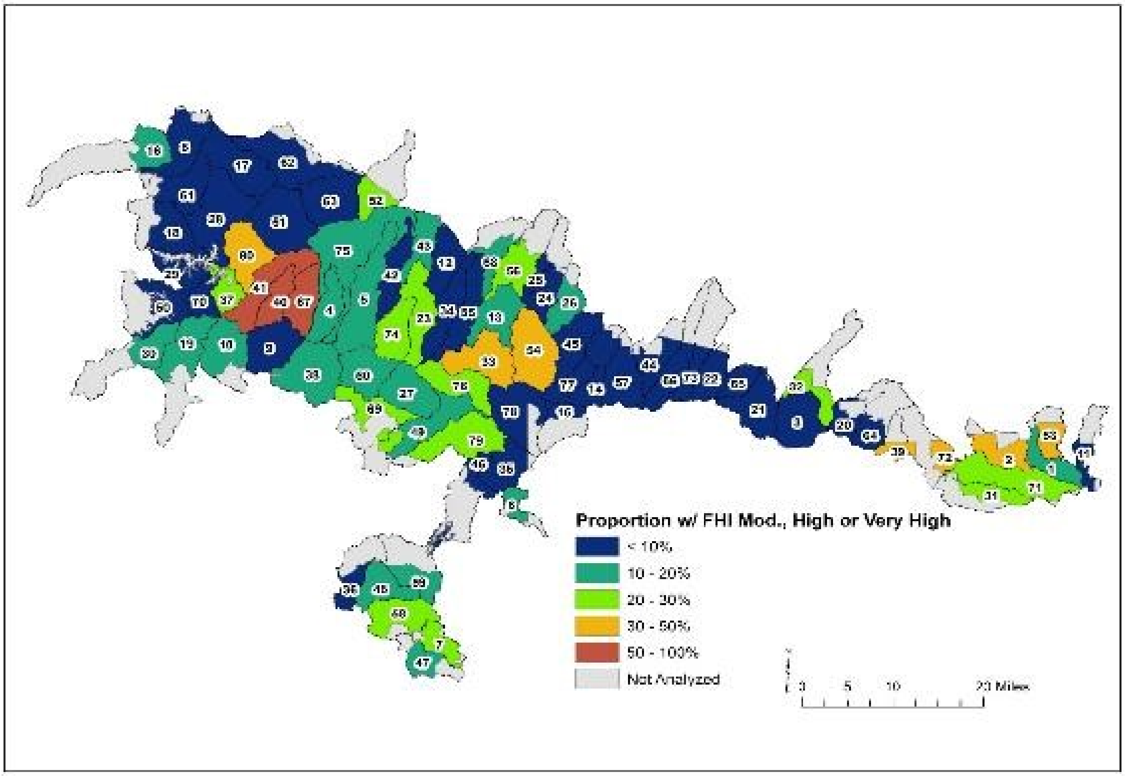


Figure 66. Proportion of each HUC6 watershed with moderate, high, or very high fire hazard index for Alternative 2, under modeled weather conditions

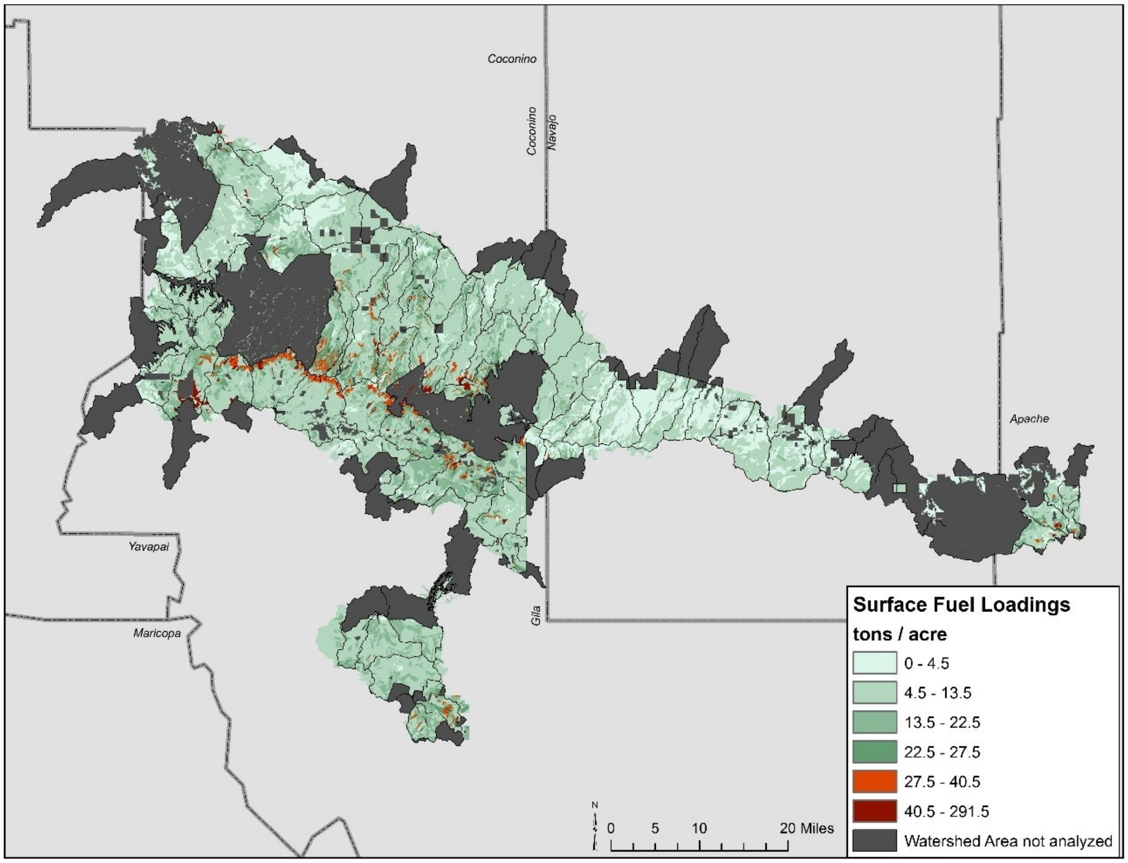


Figure 67. Surface fuel loading in tons per acre for alternative 2, areas in orange and red exceed recommended levels.

Effects on Values, Resources and Assets

Wildfire Management

Wildfire management environment would become safer and more effected as both active crown fire (CFA) and fire hazard index (FHI) decrease. Even under extreme fire weather, suppression tactics would be more effective than current conditions. Decision space for managing unplanned ignitions would expand as Rim Country is implemented.

WUI

Under the Alternative 2, WUI areas on Forest Service lands across the treatment area would be more fire adapted, however increasing smoke from prescribed fires would be present next to homes. CFA and FHI both decrease on Forest Service lands (Table 35). The potential for home and asset loss from crown fires, high intensity surface fires and ember lofting from fires on Forest Service land would decrease. The need for private and non-forest service land owners to manage fuels on their lands in order to compliment Rim Country initiatives will be imperative to fully mitigate risk and impacts from wildfires.

Table 35. Alternative 2 metrics for the Wildland Urban Interface (WUI)

WUI CLASS	Total Acres	very Low - Low FHI	moderate FHI	high FHI	very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
High Value Rec Sites	375	36%	6%	6%	5%	64%	10%
Comm Sites	2074	35%	6%	2%	0%	65%	6%
Non FS Lands	22638	43%	6%	1%	0%	57%	6%
Transmission Lines	4083	39%	6%	1%	0%	61%	6%
FS Buildings	1683	33%	6%	4%	1%	67%	5%

FS – Forest Service

Vegetation Cover Type

At the project scale, active crown fire and fire hazard index are reduced for all target vegetation cover types (Table 36). At the project area scale, ponderosa pine would meet desired conditions for active crown fire (less than 10), under Alternative 2 even under the extreme conditions modeled.

Table 36. Alterative 2 metrics for vegetation cover type

Vegetation Cover type	Total Acres	very Low - Low FHI	moderate FHI	high FHI	very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
Ponderosa Pine	556284	97%	2%	1%	0%	81%	**1%**
PIPO Evergreen Oak	147989	95%	4%	1%	0%	85%	**0%**
Dry Mixed Conifer	49281	74%	10%	9%	7%	77%	11%
Wet Mixed Conifer	3130	83%	4%	7%	6%	74%	13%
Aspen	1438	98%	1%	1%	0%	6%	2%
Pinyon Juniper	135085	74%	22%	4%	0%	71%	25%
Madrean Pinyon Oak	23318	55%	25%	19%	1%	86%	41%
Grasslands	18851	100%	0%	0%	0%	16%	**0%**
Riparian Areas	14567	92%	5%	2%	1%	48%	2%

Large and old trees

Under Alternative 2, the potential for fire-related mortality of large and/or old trees would be reduced across the landscape. Ignition techniques or other mitigations would be employed to minimize residence time in duff adjacent to old trees whenever possible. Under this alternative, low severity fire would be used in the vicinity of old trees and, to the degree it is practicable, ladder fuels and excessive surface fuel buildups adjacent to old trees would be removed before burning. Scorch is one of the primary factors in large and old tree mortality (Jerman et al. 2004), and is influenced by the vertical arrangement of fuels.

Prescribed fire and mechanical treatments in the vicinity of old and/or large trees would decrease fuel loading in the immediate vicinity of these trees, decreasing the potential for crown scorch.

Emissions and Air Quality

This alternative would meet the purpose and need, and desired conditions for Air Quality. During windows of opportunity, whenever fire weather and expected fire effects are favorable, fire managers on the Apache-Sitgreaves, Coconino and Tonto National Forests strive to treat as many acres with wildland fire as possible every year, while remaining within legal, climatological, social, and logistical limits. This means that the only change that is likely to occur under this Alternative would be from the greater flexibility in blocking out burn units, because so much more area would have been treated and/or planned and analyzed for prescribed fire. There may also be room some potential for increased coordination of resources between forests in the area. Impacts on air quality are indirect effects of implementing prescribed fire. Although the impact of this is not quantifiable at this time, it would likely be an increase in annual acres burned with no increase in air quality impacts, because it could increase the number of acres that could be burned in a single burn period.

The number of days (duration) of smoke impacts, as well as the intensity (concentration) of the impacts are of concern to the public. While the variability from year to year would be large, under this alternative, prescribed fire would need to be implemented on up to 58,333 acres annually to produce an average fire return interval of 10 years across 583,330 acres proposed for prescribed fire. Potential air quality impacts during implementation of Alternative 2, and the necessary maintenance burning after the initial implementation has been completed may be noticeable, although National Ambient Air Quality Standards would not be exceeded.

First entry burns produce much more emissions per acre than subsequent burns. However, even if the slash was removed from the forest and although the prescribed burning would be spread over many years, the area to be burned would increase significantly and periodic burning would be required across the treatment area to maintain a low fuel load and a healthy forest. Any wildfire that burned subsequent to implementing Alternative 2 would result in lower emissions than if the area burned in a wildfire given current conditions because there would be less biomass to burn Figure 68).

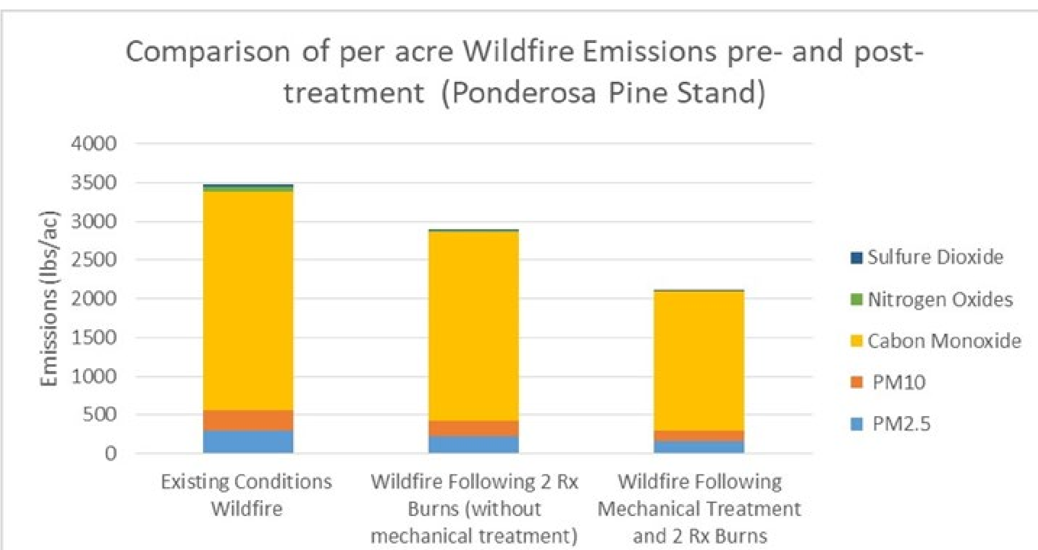


Figure 68. Comparison of per acre wildfire emissions pre- and post- treatments for a Ponderosa Pine Stand

The amount of smoke allowed by the DEQ would not increase, and any burning done in the proposed treatment areas would comply with the National Ambient Air Quality Standards (NAAQS). The number of days of smoke impacts, as well as nuisance smoke (emissions that comply with NAAQS but are considered by the public to be a nuisance) may increase under this alternative, for the following reasons. The Apache-Sitgreaves, Coconino and Tonto National Forests already burn on the high end of what would be their maximum acres and allowed emissions.

Under Alternatives 2, the number of acres available for prescribed fire would increase by 953,132 acres, which could average an additional 58,333 acres a year with prescribed fire and wildfire. This, in turn, would increase the flexibility for the forests in laying out burn units and managing prescribed fires. With potential for larger burn units, it would be possible to burn 'hotter', so that, although more acres may be burned at one time, the heat created by increased fire behavior is could provide more 'lift' for the smoke, increasing dispersal and minimizing smoke impacts.

Overall, surface fuel loading would decrease with a corresponding decrease in the volume of potential emissions from wildfires and future prescribed fires. However, there is no projected change in CWD fuel loading for Very Low (PAC Burn Only) treatments, and in these areas, smoldering fuels would produce high levels of smoke, as well as a high likelihood of high severity fire effects.

The likelihood and degree of potential impacts from wildfire smoke would decrease as fuel loading decrease after prescribed burns. After implementation, Watersheds 75 (East Clear Creek-Clear Creek) and 33 (Long Tom canyon-Chevelon Canyon) have the greatest potential to produce emissions because of surface fuel loading. Under Alternative 2 all but 22 watersheds decrease in total surface fuel loadings. One remains effectively the same (56, Durfee Draw – Chevelon Canyon), and 20 increase in fuel loadings Watershed 2 (Upper Rocky Arroyo) and 41 (East Clear Creek) increase the most (29 and 23 percent respectively).

Alternative 3 – Focused Restoration

From a fire ecology perspective, direct and indirect effects of Alternative 3 relate primarily to treatments that include mechanical thinning, prescribed fire, or both to meet the purpose and need of the Rim Country. This alternative proposes to conduct about 528,060 acres of restoration activities over about 10 years or until objectives are met. On average, 48,316 acres of vegetation would be mechanically treated annually. On average, 52,806 acres of prescribed fire would be implemented annually across the Forests (within the treatment area). Up to two prescribed fires would be conducted on all acres proposed for burning over the 10-year period.

Direct and Indirect Effects

From a fire ecology perspective, direct and indirect effects of Alternative 3 relate primarily to treatments that include mechanical thinning, prescribed fire as described in the section Effects Common to All Action Alternatives, page 229. Areas without treatments will have the indirect effects associated with Alternative 1.

Rim Country Project Area Metrics and Measures

Fire Type

Alternative 3 is expected to reduce the potential for active and conditional crown fire closer to desired conditions for all vegetation cover types (see Table 38 below), however desired conditions will not be fully attained. Over the rim country project area, 18 percent of the area burned under extreme weather conditions would be expected to be active or conditional crown fire, down from 31 percent given existing conditions (Figure 69). Passive crown fire increases slightly (56 percent up from 47 percent EC) under extreme conditions, due to the desired clumpy canopy characteristics of the mechanical treatments. Under less extreme wind conditions (5 MPH instead of 20 MPH), the majority of the landscape would be expected to burn as a surface fire, and only limited acres would be expected to burn with active crown fire.

Post wildfire watershed effects increase with the amount of a watershed that burns at high severity fire (Cannon 2010; Neary 2011). Under Alternative 3, 16 watersheds have expected active crown fire under extreme weather conditions for over 30 percent of the watershed, which would result in high severity effects (Figure 73). Six watersheds are have over 50 percent of the watershed expected to burn with active crown fire. Watersheds 67 (Bear Canyon) and 56 (Durfee Draw-Chevelon Canyon) have the highest proportion of potential for active crown fire (55 percent and 67 percent respective). If a wildfire were to burn within these watersheds, detrimental post wildfire effects would be expected.

Fire Hazard Index

Alternative 3 would decrease the risk of undesirable wildfire behavior and effects that could threaten lives, resources, and infrastructure. After implementation, the fire hazard index decreases resulting in 22 percent of the project area is within the moderate to very high FHI (Figure 70), down from 37 percent in the existing conditions. The areas of moderate to extreme presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality.

There are 6 watersheds with over 50 percent of the watershed in the moderate to very high FHI categories (Figure 72). Watershed 67 (Bear Canyon, 65 percent) and 59 (Upper Spring Creek, 77 percent) have the highest proportion of FHI in the moderate to very high class. Large wildfires in these watersheds have a high potential to be difficult and dangerous to suppress, and have a high potential for adverse post fire effects.

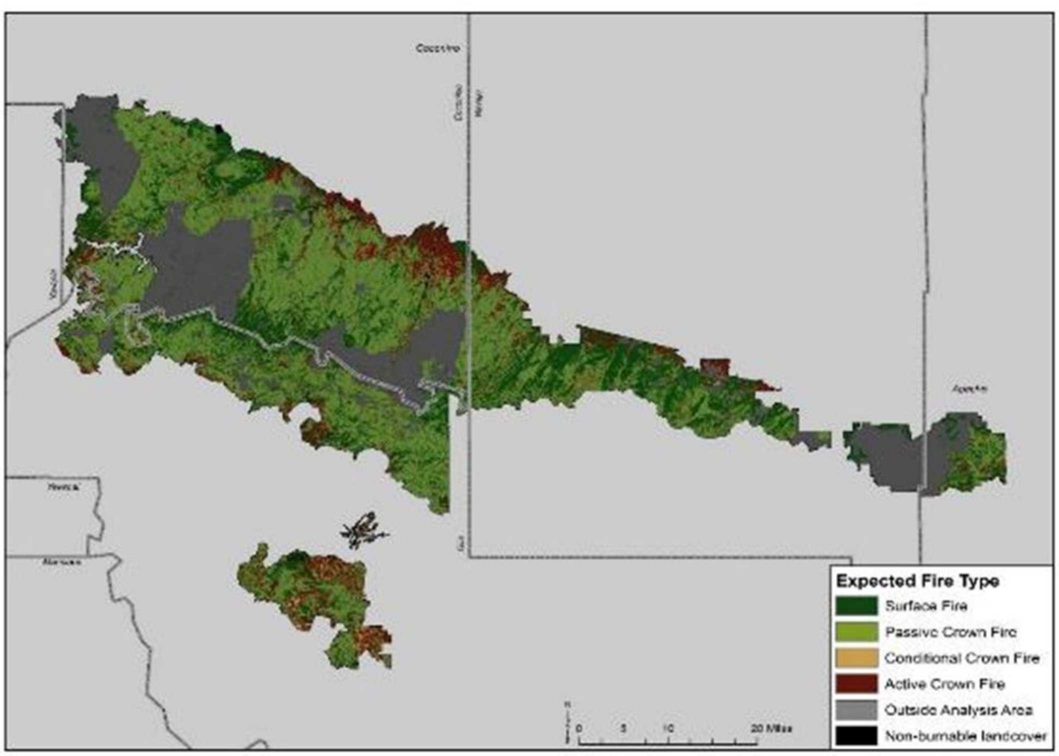


Figure 69. Expected Fire Type for Alternative 3, under modeled weather conditions

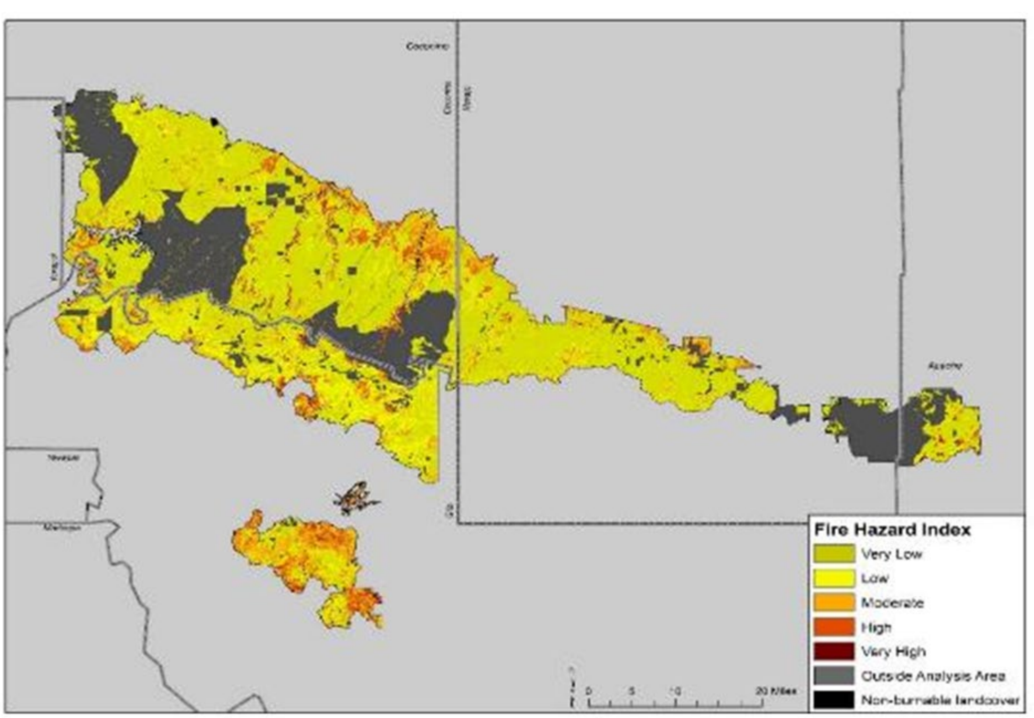


Figure 70. Fire Hazard Index for Alternative 3, under modeled weather conditions

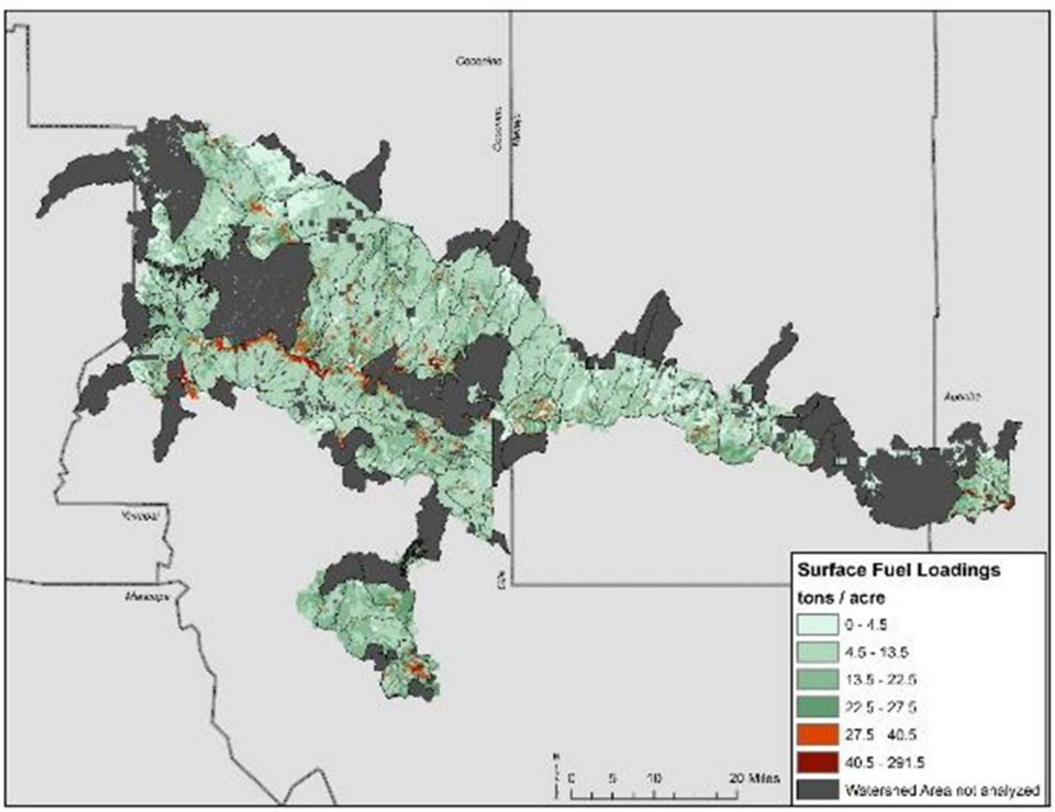


Figure 71. Total Surface Fuel Loadings for Alternative 3, under modeled weather conditions

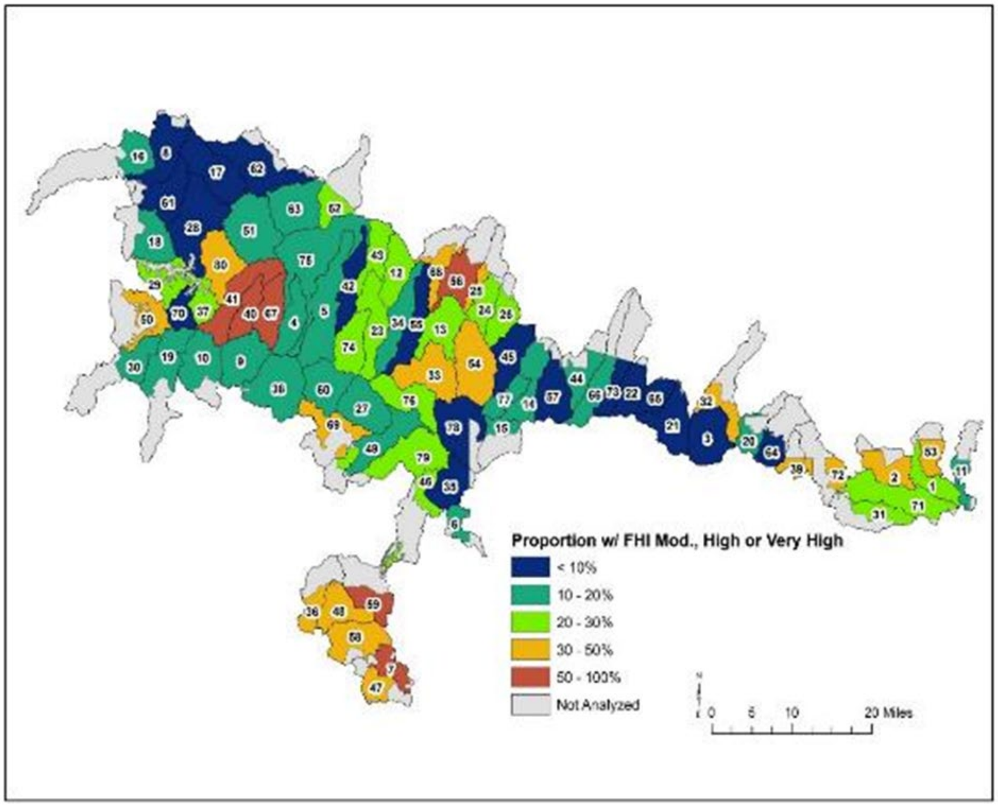


Figure 72. Proportion of each HUC6 watershed with Moderate, High, or Very High Fire Hazard Index for Alternative 2, under modeled weather conditions

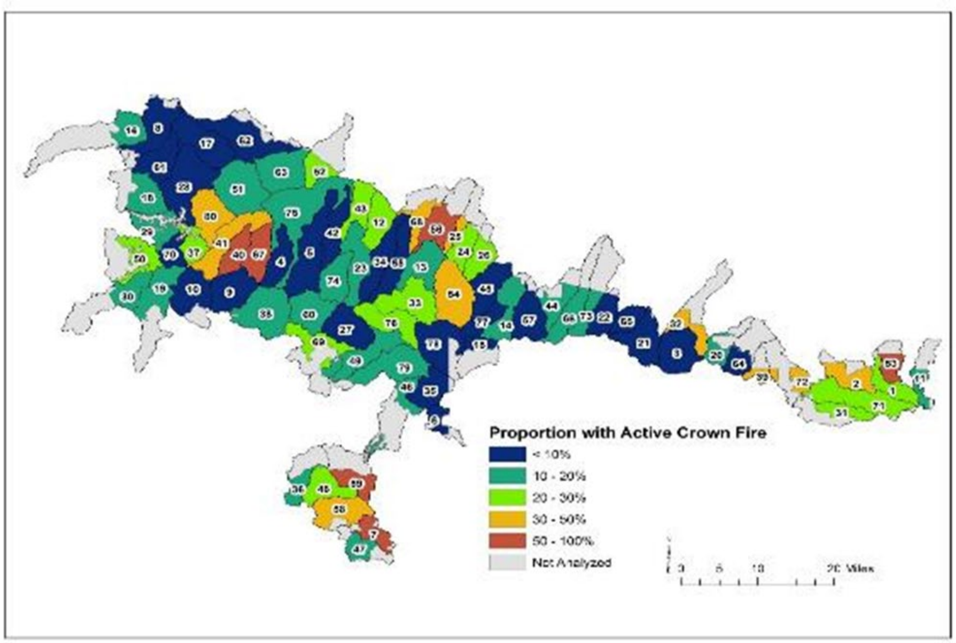


Figure 73. Proportion of each HUC6 watershed with Active Crown Fire for Alternative 3, under modeled weather conditions

Surface Fuel Loadings

Under the Alternative 3, surface fuel loading would initially increase with mechanical treatment, and would also increase where no treatments occur. As first and second entry prescribed burns are implemented, these fuel loadings would decrease in most areas except those proposed for MSO treatments, which are designed to maintain a higher level of fuel loading, especially Coarse Woody Debris (dead/down woody fuels greater than 3" in diameter).

Desired conditions for total surface fuel loadings are less than 27 tons/ac in Ponderosa Pine vegetation types and less than 30 tons/ac in Dry Mixed Conifer. Figure 71 highlights those areas where surface fuel loading is expected to exceed desired conditions under Alternative 3.

Effects on Values, Resources and Assets

Wildfire Management

Wildfire management environment would become safer and more effected as both CFA and FHI decrease. However in areas where no treatments are planned, CFA and FHI both increase. Even under extreme fire weather, suppression tactics would be more effective than current conditions. Decision space for managing unplanned ignitions would expand as Rim Country (and other projects) are implemented.

WUI

Under Alternative 3, WUI areas on Forest Service lands across the treatment area would be more fire adapted, however increasing smoke from prescribed fires would be present next to homes. CFA and FHI both decrease on Forest Service lands (Table 37). The potential for home and asset loss from crown fires, high intensity surface fires and ember lofting from fires on Forest Service land would decrease. The need for private and non-forest service land owners to manage fuels on their lands in order to compliment Rim Country initiatives will be imperative to fully mitigate risk and impacts from wildfires.

Table 37: Alternative 3 metrics for the Wildland Urban Interface

WUI CLASS	Total Acres	very Low - Low FHI	moderate FHI	high FHI	very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
High Value Rec Sites	375	81%	8%	6%	5%	65%	11%
Comm Sites	2074	86%	8%	6%	1%	68%	11%
Non FS Lands	22638	87%	8%	4%	0%	63%	10%
Transmission Lines	4083	84%	10%	6%	1%	65%	15%
FS Buildings	1683	80%	8%	10%	3%	71%	14%

FS-Forest Service

Vegetation Cover Type

At the project scale, active crown fire and fire hazard index are reduced for all target vegetation cover types (Table 38). At the project area scale, ponderosa pine would not meet desired conditions for active crown fire (<10 percent), under Alternative 3 under the extreme conditions modeled, however it would move the cover type closer to desired conditions.

Table 38: Alternative 3 metrics by Vegetation Cover class

Vegetation Cover type	Total Acres	very Low - Low FHI	moderate FHI	high FHI	very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
Ponderosa Pine	556284	75%	7%	16%	3%	75%	22%
PIPO Evergreen Oak	147989	36%	33%	26%	5%	62%	30%
Dry Mixed Conifer	49281	26%	17%	28%	29%	29%	54%
Wet Mixed Conifer	3130	29%	4%	26%	41%	30%	70%
Aspen	1438	95%	1%	3%	2%	4%	5%
Pinyon Juniper	135085	36%	33%	28%	3%	53%	67%
Madrean Pinyon Oak	23318	19%	33%	41%	7%	55%	80%
Grasslands	18851	98%	2%	0%	0%	3%	3%
Riparian Areas	14567	70%	11%	13%	6%	35%	19%

Large and old trees

Under Alternative 3, the potential for fire-related mortality of large and/or old trees would be reduced across the landscape where treatments are implemented in the same manner as Alternative 2. In areas where no treatments are applied, old trees would respond as in Alternative 1.

Emissions and Air Quality

This alternative would meet the purpose and need, and desired conditions for Air Quality. Effects to Air Quality from smoke emissions will be a mix of Alternative 1 and Alternative 2. 528,060 acres would be treated resulting in lower emissions from a post-treatment wildfire. And, 528,060 acres would increase in potential wildfire emissions due to increases in surface fuel loadings and crown fire potential.

The number of days (duration) of smoke impacts, as well as the intensity (concentration) of the impacts are of concern to the public. While the variability from year to year would be large, under Alternative 3, prescribed fire would need to be implemented on up to 52,806 acres annually to produce an average fire return interval of 10 years across 528,060 acres proposed for prescribed fire. Implementing prescribed fire as proposed in Alternative 3 would result in lower emissions than if the area burned in a wildfire because there would be less biomass to burn (Figure 68).

Under Alternatives 3, the number of acres available for prescribed fire would increase by 52,806 acres, this, in turn, would increase the flexibility for the forests in laying out burn units and managing prescribed fires. With potential for larger burn units, it would be possible to burn ‘hotter’, so that, although more acres may be burned at one time, the heat created by increased fire behavior is could provide more ‘lift’ for the smoke, increasing dispersal and minimizing smoke impacts.

Surface fuel loading would decrease where treatments are implemented, decreasing the volume of potential emissions from wildfires and future prescribed fires. However, there is no change in CWD fuel loading for Very Low (PAC Burn Only) treatments. In these areas, smoldering fuels would produce high levels of smoke, as well as a high likelihood of high severity fire effects.

The likelihood and degree of potential impacts from wildfire smoke would decrease as fuel loading decrease after prescribed burns. After implementation, Watersheds 75 (East Clear Creek-Clear Creek) and 79 (Haigler Creek) have the greatest potential to produce emissions because of surface fuel loading (Figure 43 of Fire Ecologist Specialist Report 2019). Under Alternative 3 all but 46 watersheds decrease in total surface fuel loadings. Five remain effectively the same (< 3 percent change), and 41 increase in fuel loadings (see Table 44 below). Watershed 1 (Upper Rocky Arroyo) and 133 (Decker Wash) increase the most (29 percent and 28 percent respectively).

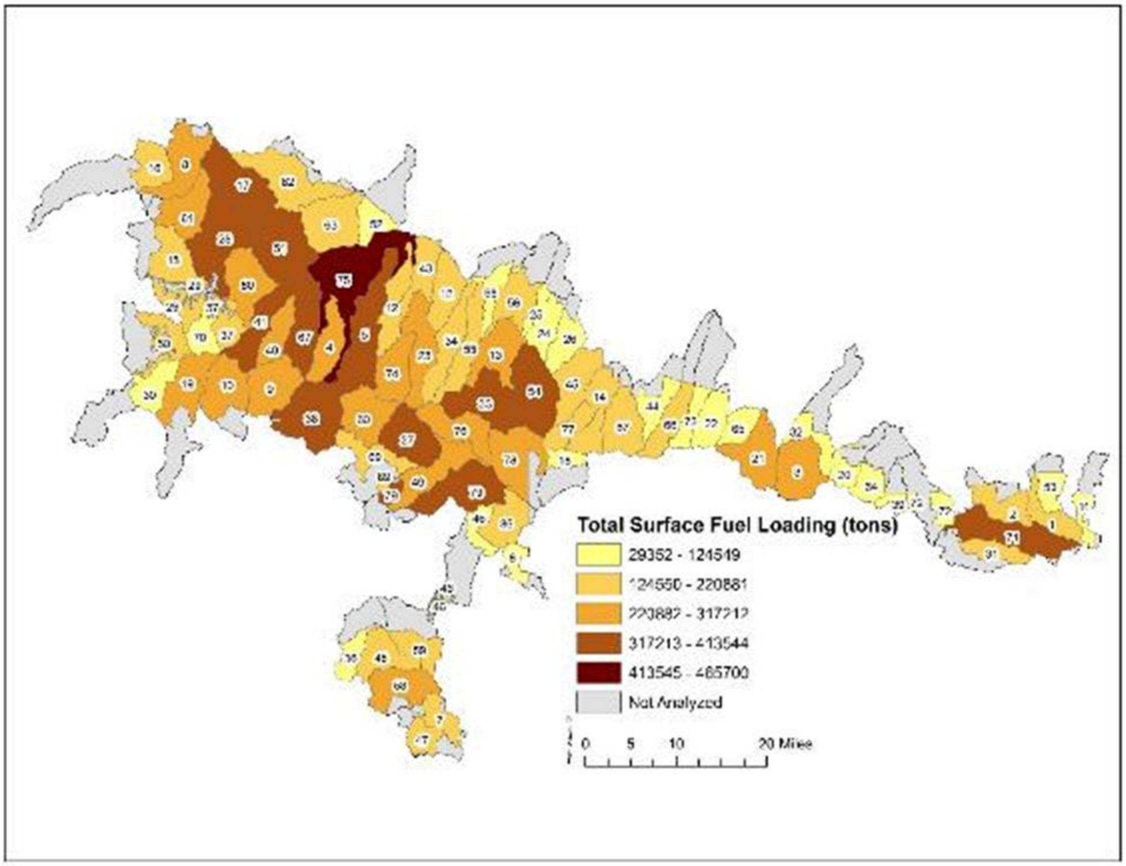


Figure 74. Total Surface Fuel loadings of each HUC-6 watershed for Alternative 3, as modeled using FVS

Comparison of Alternatives

This report analyzed the effectiveness of three alternatives for modifying composition, pattern, and structure as a means of restoring healthy ecological function to ponderosa pine, specifically in regards to fire ecology and air quality. All action alternatives are expected to reset the current trajectory of areas proposed for treatment towards greater sustainability and resilience. Aspen, grasslands, oak communities, and some pinyon/juniper communities associated with ponderosa pine are included. Restoring historic fire regimes plays both direct and indirect roles in achieving or maintaining desired conditions for these vegetation communities. All action alternatives move the Rim Country proposed treatment area toward desired conditions. Differences between them are discussed below, and summarized at the end of this section.

Fire Type

The change from existing conditions to post-treatment conditions in the action alternatives results primarily from: 1) mechanical treatments breaking up the vertical and horizontal continuity of canopy fuels; 2) mechanical treatments and prescribed fire raising canopy base heights; and 3).

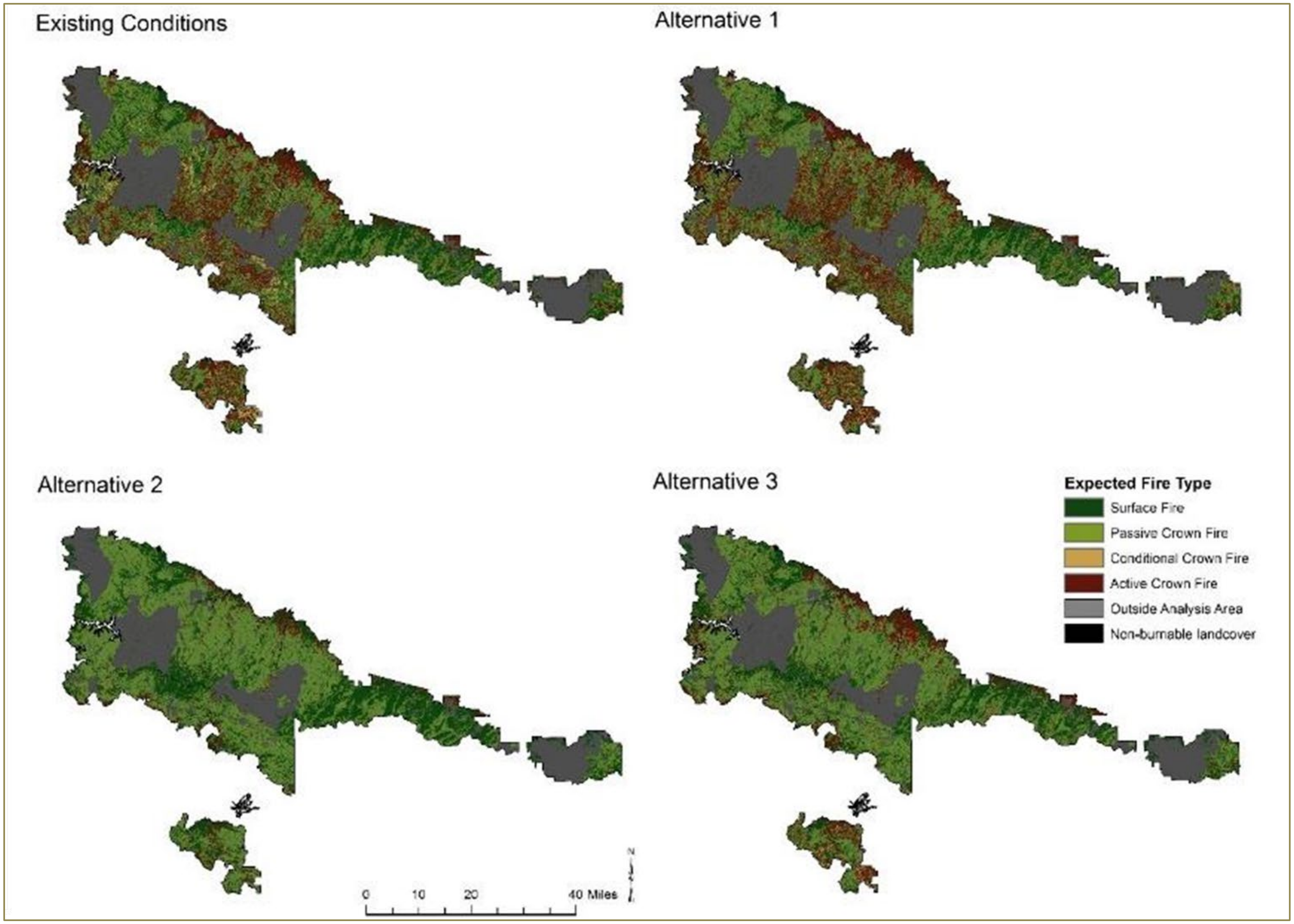


Figure 75. Comparison of fire type for each alternative

Table 39: Comparison of Alternatives Fire Type within the Wildland Urban Interface. The ↑ symbol indicates increases compared to existing conditions (EC), while the ↓symbol indicate decreases.

WUI CLASS	Total Acres	Passive & Active Crown Fire: Existing Conditions	Passive & Active Crown Fire: ALT1	Passive & Active Crown Fire: ALT2	Passive & Active Crown Fire: ALT3	Active Crown Fire: Existing Conditions	Active Crown Fire: ALT1	Active Crown Fire: ALT2	Active Crown Fire: ALT3
High Value Rec Sites	375	79%	↑83%	↓64%	↓65%	38%	↑40%	↓10%	↓11%
Communication Sites	2074	75%	↑79%	↓65%	↓68%	27%	↑28%	↓6%	↓11%
Non FS Lands	22638	68%	↑73%	↓57%	↓63%	28%	↑29%	↓6%	↓10%
Transmission Lines	4083	66%	↑74%	↓61%	↓65%	32%	↑33%	↓6%	↓15%
FS Buildings	1683	83%	↑85%	↓67%	↓71%	41%	↑43%	↓5%	↓14%

FS-Forest Service

Desired condition for ponderosa pine is to have potential for less than 20 percent crown fire.

Table 40: Comparison of Alternatives for Fire Type by vegetation cover class for extreme fire weather

Vegetation Cover Type	Total Acres	Passive & Active Crown Fire: Existing Conditions	Passive & Active Crown Fire: ALT1	Passive & Active Crown Fire: ALT2	Passive & Active Crown Fire: ALT3	Active Crown Fire: Existing Conditions	Active Crown Fire: ALT1	Active Crown Fire: ALT2	Active Crown Fire: ALT3
Ponderosa Pine	556284	72%	81%	75%	79%	21%	22%	1%	5%
Ponderosa Pine Evergreen Oak	147989	82%	85%	62%	72%	29%	30%	0%	9%
Dry Mixed Conifer	49281	75%	77%	29%	33%	50%	54%	11%	14%
Wet Mixed Conifer	3130	71%	74%	30%	30%	66%	70%	13%	14%
Aspen	1438	6%	6%	4%	4%	4%	5%	2%	2%
Pinyon Juniper	135085	71%	71%	53%	62%	65%	67%	25%	49%
Madrean Pinyon Oak	23318	85%	86%	55%	71%	79%	80%	41%	59%
Grasslands	18851	15%	16%	3%	5%	3%	3%	0%	5%
Riparian Areas	14567	44%	48%	35%	35%	18%	19%	2%	2%

Fire Hazard Index

Overall, fire hazard index ratings are expected to increase under the no action alternative (alternative 1) and would decrease under both alternatives 2 and 3 (Figure 76). The biggest decrease in FHI would occur under alternative 2 (Table 41).

Under alternative 1, the percentage of the total project area with moderate to very high fire hazard index (FHI) rating is expected to increase from 37 percent under existing conditions to 40 percent and an additional two subwatersheds would have greater than 50 percent moderate to very high ratings when compared to existing conditions. Alternative 2 would provide the biggest decrease in FHI, reducing the percent of the project area in moderate to very high down to 15 percent and reducing the number of subwatersheds as such to three. Alternative 3 also provides for a significant reduction in FHI, though not to the same degree as alternative 2.

An overall comparison of fire hazard index across alternatives is presented in Figure 76. Alternative 1 results in the largest percentage of the project area in the moderate, high and extreme FHI classes. Alternative 2 provides for the largest overall reduction in FHI for the project area as a whole, while Alternative 3 shows significant reductions in FHI ratings across much of the project area, though less so than Alternative 2.

To further understand the impacts of each proposed alternative based on fire hazard index, it is useful to examine the relative change in FHI rating classes within select areas of interest, especially within Wildland Urban Interface (WUI) classes. As shown in table 40, Alternative 1 results in a relative increase in the amount of acreage in the high and very high FHI classes across nearly all WUI Classes. Both Alternative 2 and Alternative 3 show a relative decline in the area of high and very high FHI classes, with a corresponding increase in the area rated as very low-low FHI. This illustrates the effectiveness of both alternatives in reducing the overall fire hazard index rating across all WUI classes. The differences between Alternative 2 and Alternative 3 are limited, reflecting the emphasis of treatment in and adjacent to the WUI areas in both action alternatives. Table 43 provides a further examination of the relative changes in FHI for each vegetation cover type across all alternatives.

Table 41: Comparison of alternatives for Fire Hazard Index ratings

Fire Hazard Index (FHI)	Existing Conditions	Alt 1	Alt 2	Alt 3
Percent of Project Area with Moderate to Very High FHI:	37%	40%	15%	22%
Number of Subwatersheds with >50% of their area in Moderate to Very High FHI:	23	25	3	6

A comparison of FHI by WUI Class and Vegetation Cover Type are displayed in Table 42 and Table 43 respectively.

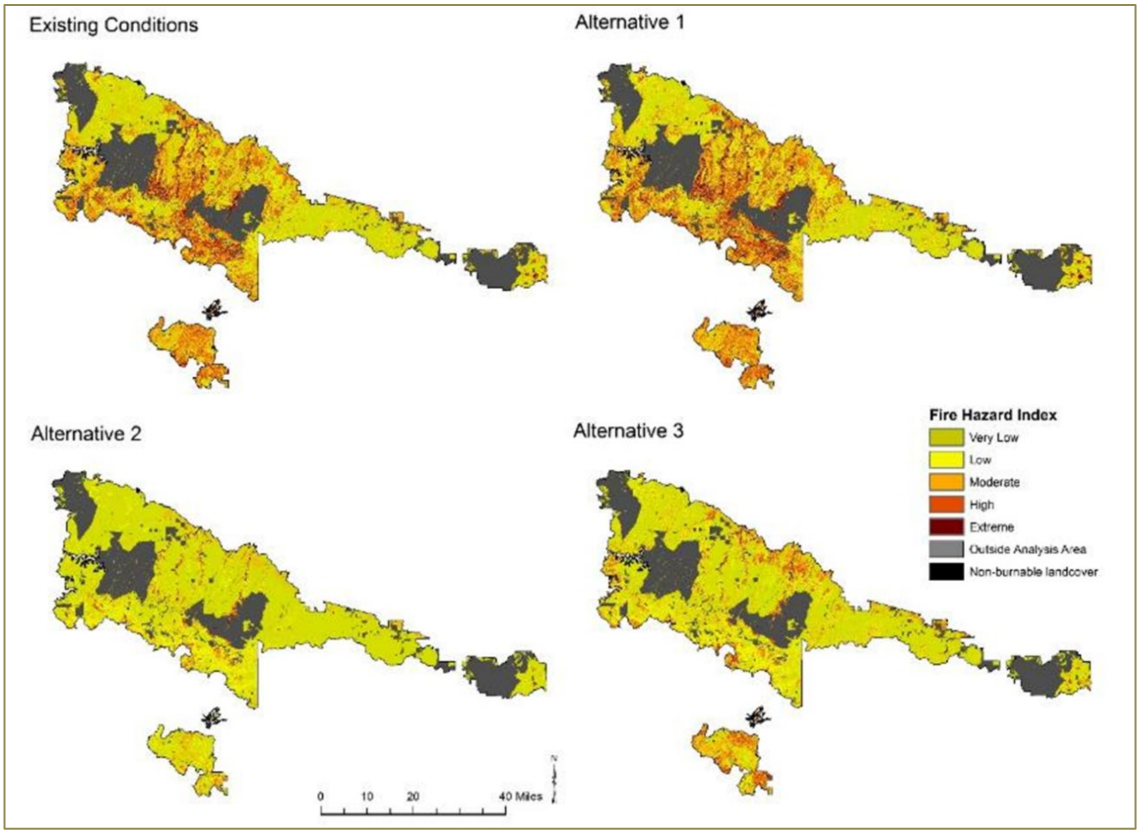


Figure 76. Fire hazard index

Table 42: Comparison of Alternatives by Fire Hazard Index for the Wildland Urban Interface Classes

WUI Class	Total Acres	Very Low-Low FHI: Existing Conditions	Very Low-Low FHI: ALT1	Very Low-Low FHI: ALT2	Very Low-Low FHI: ALT3	Moderate FHI: Existing Conditions	Moderate FHI: ALT1	Moderate FHI: ALT2	Moderate FHI: ALT3	High FHI: Existing Conditions	High FHI: ALT1	High FHI: ALT2	High FHI: ALT3	Very High FHI: Existing Conditions	Very High FHI: ALT1	Very High FHI: ALT2	Very High FHI: ALT3
High Value Rec Sites	375	49%	45%	83%	81%	16%	19%	6%	8%	18%	18%	6%	6%	16%	19%	5%	5%
Comm Sites	2074	66%	63%	92%	86%	15%	16%	6%	8%	17%	18%	2%	6%	2%	3%	0%	1%
NonFS Lands	22638	66%	63%	93%	87%	16%	17%	6%	8%	15%	18%	1%	4%	3%	3%	0%	0%
Transmission Lines	4083	64%	61%	93%	84%	18%	17%	6%	10%	15%	18%	1%	6%	3%	4%	0%	1%
FS Buildings	1683	51%	49%	89%	80%	14%	14%	6%	8%	27%	29%	4%	10%	8%	9%	1%	3%

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Table 43: Comparison of Alternatives by Fire Hazard Index for each Vegetation Cover Type

Vegetation Cover Type	Total Acres	Very Low - Low FHI: Existing Conditions	Very Low - Low FHI: ALT1	Very Low - Low FHI: ALT2	Very Low - Low FHI: ALT3	Moderate FHI: Existing Conditions	Moderate FHI: ALT1	Moderate FHI: ALT2	Moderate FHI: ALT3	High FHI: Existing Conditions	High FHI: ALT1	High FHI: ALT2	High FHI: ALT3	Very High FHI: Existing Conditions	Very High FHI: ALT1	Very High FHI: ALT2	Very High FHI: ALT3
Ponderosa Pine	556284	77%	75%	97%	93%	9%	7%	2%	3%	12%	16%	1%	3%	2%	3%	0%	0%
Ponderosa Pine Evergreen Oak	147989	41%	36%	95%	75%	31%	33%	4%	16%	24%	26%	1%	8%	4%	5%	0%	1%
Dry Mixed Conifer	49281	29%	26%	74%	70%	18%	17%	10%	12%	27%	28%	9%	11%	26%	29%	7%	8%
Wet Mixed Conifer	3130	32%	29%	83%	82%	5%	4%	4%	4%	25%	26%	7%	7%	38%	41%	6%	6%
Aspen	1438	95%	95%	98%	97%	1%	1%	1%	1%	3%	3%	1%	1%	2%	2%	0%	0%
Pinyon Juniper	135085	37%	36%	74%	53%	34%	33%	22%	27%	26%	28%	4%	19%	2%	3%	0%	1%
Madrean Pinyon Oak	23318	20%	19%	55%	37%	31%	33%	25%	30%	43%	41%	19%	29%	6%	7%	1%	4%
Grasslands	18851	98%	98%	100%	100%	2%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Riparian Areas	14567	74%	70%	92%	92%	11%	11%	5%	5%	11%	13%	2%	2%	5%	6%	1%	1%

Surface Fuel Loading

Total surface fuel loadings is expected to increase under alternative 1, compared with existing conditions. Both alternatives 2 and 3 would reduce total surface fuel loadings, with the biggest reductions occurring under alternative 2 (Figure 16). Table 44 shows the percent change in total surface loading for each subwatershed in the project area under each alternative.

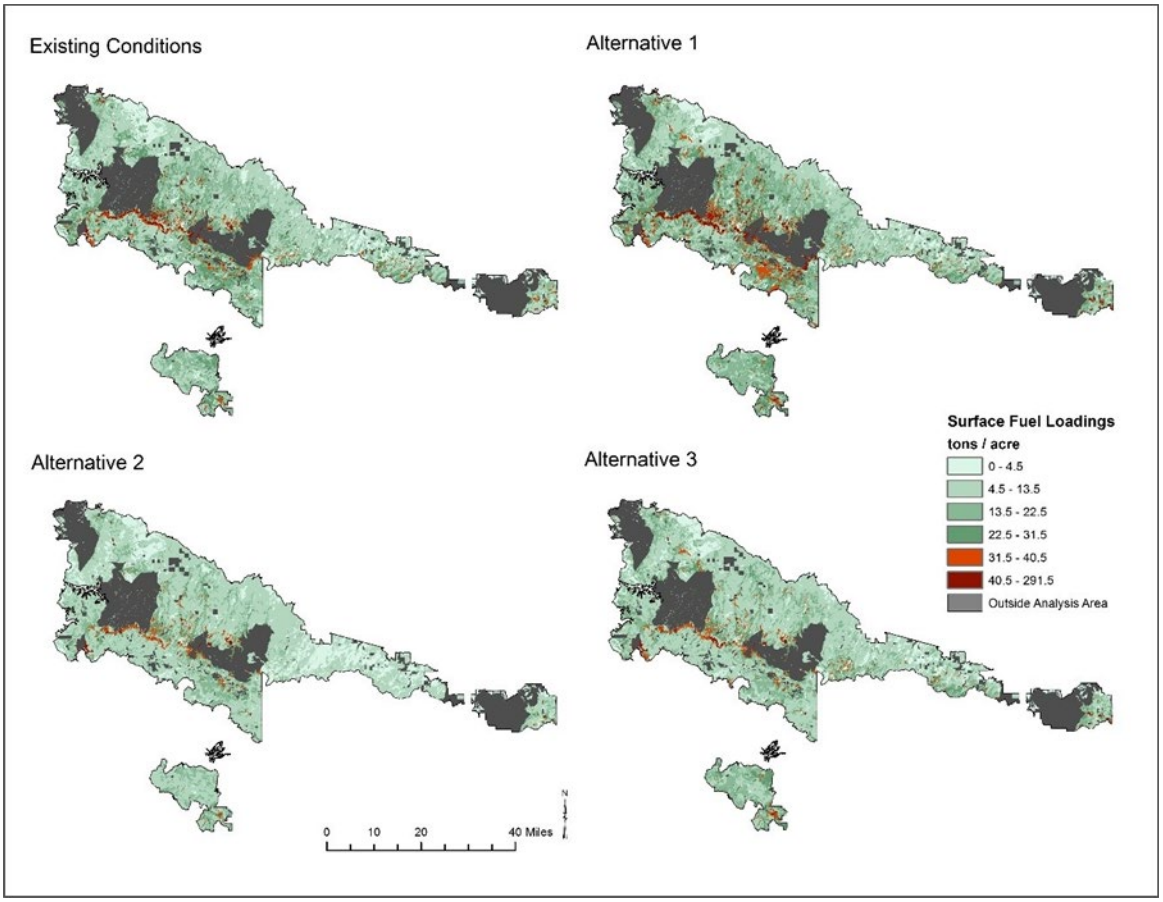

Figure 77. Comparison of Total Surface Fuel Loading

Table 44: Comparison of Percent Changes in Total Surface Fuel Loadings from existing conditions

Map Label	Watershed Name	Existing Total SFL	ALT 1 % Change	ALT 2 % Change	ALT 3 % Change
1	Upper Brown Creek	143,874	26%	-10%	10%
2	Upper Rocky Arroyo	117,828	30%	29%	29%
3	Mortensen Wash	238,345	9%	-55%	-7%
4	Barbershop Canyon	316,351	19%	-22%	-22%
5	Leonard Canyon	490,214	19%	-22%	-22%
6	Gentry Canyon	77,488	16%	-25%	-25%
7	Reynolds Creek	176,637	20%	-19%	7%
8	Double Cabin Park-Jacks Canyon	264,058	17%	7%	10%
9	East Verde River Headwaters	389,775	12%	-27%	-26%
10	Webber Creek	327,236	16%	-16%	-16%
11	Sepulveda Creek	72,897	23%	-23%	-1%
12	Cabin Draw	159,183	24%	-21%	0%
13	Upper Chevelon Canyon-Chevelon Canyon Lake	234,868	25%	-10%	2%
14	Bear Canyon-Black Canyon	185,764	16%	-46%	8%
15	Bull Flat Canyon	79,640	6%	-47%	5%
16	Red Tank Draw	194,843	14%	5%	5%
17	Upper Willow Valley	290,666	23%	-20%	10%
18	Home Tank Draw	140,654	15%	-22%	7%
19	Pine Creek	349,252	12%	-31%	-27%
20	Linden Draw	75,116	7%	-45%	-8%
21	West Fork Cottonwood Wash-Cottonwood Wash	229,322	9%	-53%	2%
22	Upper Day Wash	64,663	28%	-22%	19%
23	Upper Willow Creek	355,012	19%	-14%	-14%
24	Middle Wildcat Canyon	93,047	15%	-21%	9%
25	Lower Wildcat Canyon	28,219	18%	4%	18%
26	Upper Potato Wash	106,747	19%	-22%	-3%
27	Christopher Creek	444,690	11%	-26%	-26%
28	Lower Willow Valley	337,796	19%	-22%	2%
29	Upper West Clear Creek	148,312	19%	-22%	-12%
30	Hardscrabble Creek	148,864	13%	-30%	-25%
31	Billy Creek	118,406	22%	19%	22%
32	Dodson Wash	71,678	15%	-11%	11%
33	Long Tom Canyon-Chevelon Canyon	394,280	21%	2%	2%
34	Upper West Chevelon Canyon	271,066	20%	-24%	-24%
35	Parallel Canyon-Cherry Creek	237,399	16%	-33%	-33%
36	Rock Creek	105,061	21%	-21%	8%
37	Clover Creek	140,657	33%	15%	15%
38	Ellison Creek	397,878	17%	-15%	-4%

Map Label	Watershed Name	Existing Total SFL	ALT 1 % Change	ALT 2 % Change	ALT 3 % Change
39	Fools Hollow	49,749	19%	15%	16%
40	Miller Canyon	195,395	21%	19%	19%
41	East Clear Creek-Blue Ridge Reservoir	289,492	25%	23%	23%
42	Wilkins Canyon	210,859	24%	-27%	-23%
43	Lower Willow Creek	158,542	20%	-6%	-5%
44	Upper Pierce Wash	78,338	5%	-47%	5%
45	Upper Brookbank Canyon	182,964	23%	-26%	-12%
46	Gruwell Canyon-Cherry Creek	121,988	19%	-30%	-13%
47	Workman Creek	138,566	27%	-22%	-7%
48	Buzzard Roost Canyon	187,727	28%	-10%	10%
49	Gordon Canyon	381,345	14%	-26%	-25%
50	Upper Fossil Creek	173,917	20%	-23%	16%
51	Windmill Draw-Jacks Canyon	353,747	17%	-18%	5%
52	Hart Tank	45,265	23%	18%	18%
53	Ortega Draw	63,924	25%	18%	21%
54	Upper Wildcat Canyon	370,140	25%	5%	6%
55	Alder Canyon	214,676	23%	-23%	-19%
56	Durfee Draw-Chevelon Canyon	134,595	18%	0%	16%
57	Buckskin Wash	191,122	6%	-60%	-7%
58	Upper Salome Creek	214,917	33%	-17%	6%
59	Upper Spring Creek	179,642	22%	-27%	21%
60	Horton Creek-Tonto Creek	341,225	14%	-25%	-15%
61	Brady Canyon	222,194	17%	13%	15%
62	Tremaine Lake	129,905	28%	4%	26%
63	Dogie Tank-Jacks Canyon	142,974	20%	-6%	17%
64	Bagnal Draw-Show Low Creek	93,232	10%	-46%	-3%
65	Stinson Wash	64,844	14%	-32%	-8%
66	Upper Phoenix Park Wash	110,842	15%	-40%	15%
67	Bear Canyon	285,961	18%	17%	17%
68	Lower West Chevelon Canyon	65,172	20%	5%	19%
69	Bull Tank Canyon-Tonto Creek	164,608	22%	-24%	-12%
70	Toms Creek	125,511	29%	-17%	-17%
71	Porter Creek	319,069	27%	11%	24%
72	Show Low Lake-Show Low Creek	56,145	19%	12%	12%
73	Decker Wash	52,388	28%	-24%	28%
74	Gentry Canyon	327,002	19%	-10%	-10%
75	East Clear Creek-Clear Creek	499,780	20%	-12%	-7%
76	Woods Canyon and Willow Springs Canyon	241,500	22%	21%	21%
77	West Fork Black Canyon	122,169	16%	-49%	15%
78	Canyon Creek Headwaters	315,160	18%	-19%	-15%

Map Label	Watershed Name	Existing Total SFL	ALT 1 % Change	ALT 2 % Change	ALT 3 % Change
79	Haigler Creek	509,875	17%	-22%	-20%
80	Long Valley Draw	252,547	18%	10%	17%

Emissions and Air Quality

The amount of biomass consumed during a prescribed fire (and therefore the emissions produced) is more easily controlled than for wildfires burning on dry, hot, windy days. When comparing alternatives, all of the action alternatives propose prescribed fire at some level which could impact air quality in the surrounding communities but in a controllable manner. The post-treatment conditions from implementing these alternatives would reduce the amount of biomass available to burn during wildfire which would moderate fire behavior, fire effects, and reduce the emissions potential of wildfire occurring in those areas. Alternative 1 does not propose any prescribed burning, and would produce increasing amounts of biomass available to burn in the event of a wildfire. This would have direct and most likely uncontrollable impacts on recreation and surrounding communities from emissions, as well as longer lasting fire effects.

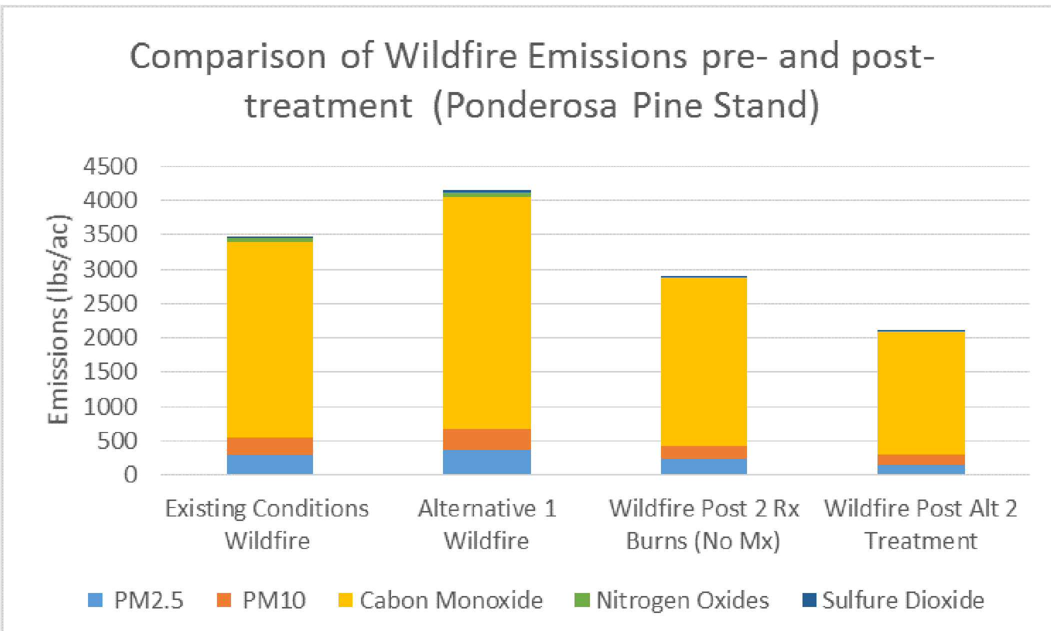

Figure 78. Comparison of Wildfire Emissions pre- and post-treatment in a Ponderosa Pine stand

Examining the cumulative effects from smoke on air quality differs from the evaluation of cumulative effects for many other resources because of the transient nature of air quality impacts. It is a relatively simple exercise to estimate the total tons per acres of emissions, but there is no calculation that correlates total annual emissions to total concentrations of emissions. As discussed earlier, air quality impacts are measured as concentrations of emissions, whether it's in µg/m3 for National Ambient Air Quality Standards (NAAQS), or in deciviews measuring visibility in Class I Areas. Cumulative effects are not the total emissions produced in a day or a year, but rather the concentration of all fire emissions in a given airshed at a given time. For NAAQS these concentrations have a varying time weighted period depending on the pollutant. For PM10 and PM2.5, they are measured as a 24 hour average, and as an annual arithmetic mean (Kleindienst 2012). The area of analysis discussed for air quality includes all three forests, the Verde River Airshed, the Lower Salt River Airshed, and the Little Colorado River Airshed (Figure 54).

The season for broadcast burning is about April through October, pile burning is most often done in the winter months, and wildfires generally occur from April through October. More acres are proposed to be burned in the implementation than are currently being burned annually on all forests, so there would be prescribed burning on more days each year. However, after the first entry burn, fuel loads would be significantly decreased, so potential tons/acre of emissions would be significantly lower. Additionally, because of the decrease in fuels, fire behavior potential would also be significantly lower, so there would be more potential to burn on days with better smoke dispersal (higher winds and more lift).

The action alternatives propose prescribed burning at different levels. There are too many variables affecting the concentration of smoke at specific locations for a given prescribed fire for a spatially explicit evaluation on the scale of this project a year (or more) in advance of implementing a burn. Burn Plans are tiered to the NEPA document for which they direct prescribed fire implementation, and include spatial modeling that identifies what effects are expected where, and helps determine conditions that would produce the desired results to minimize impacts from emissions. It is reasonable to assume there is a correlation between the amount of smoke produced in a fire, and the potential for that smoke to produce undesirable impacts.

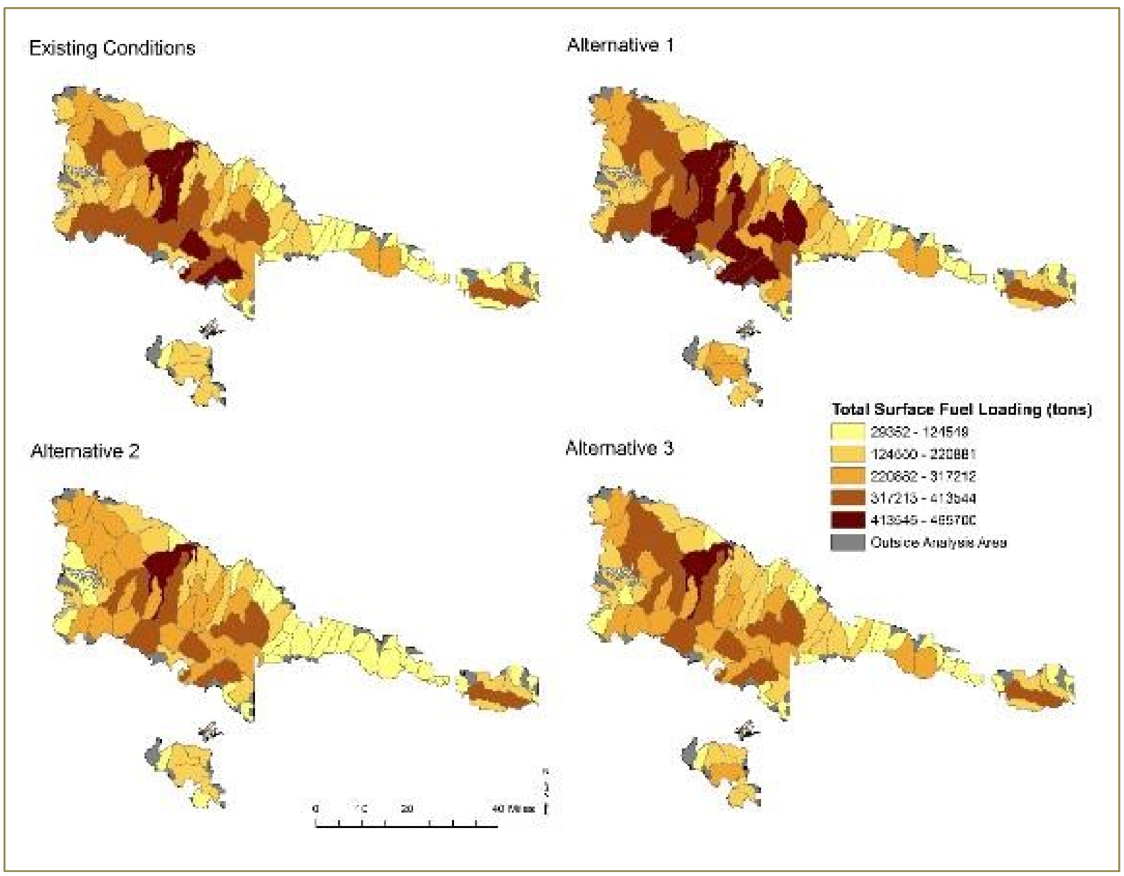

Figure 79. Surface fuel loading comparison

Cumulative Effects

Cumulative effects related to fire ecology and air quality are incremental impacts of an alternative when added to the effects of other past, present, and reasonably foreseeable future actions. These include the effects of wildfire and vegetation management activities (mechanical treatments, & prescribed fire) on fire behavior and associated fire effects, including air quality.

Geographic Scope - Cumulative effects of wildfires and other projects are considered for the approximately 1.24 million acre Rim Country project area.

Temporal Scope - This analysis primarily considered the past 10 years (2009-2018) of associated activities. This time period is based on recovery times and fuel accumulation rates associated with the ecological systems present in the Rim Country area. This analysis considered a 10 year time frame to reflect future and reasonably foreseeable activities at which time the majority of the actions proposed will have been completed.

Past Actions

Wildfire

Nearly all area of the cumulative effects analysis area has been influenced or altered by past modifications to natural fire regimes as a result of fire suppression and livestock grazing. The culmination of these impacts over more than a century has resulted in the contemporary conditions found throughout the Rim Country project area. While the primary focus of this cumulative effects analysis focusses on the previous 10 years of wildfires and activities, it is important to note the role that past management has had on influencing this landscape and creating undesirable and unnatural conditions.

From 2009 – 2018, a total of 81 large wildfires[6] burned within the project acre, representing a total of 217,780 acres burned (Figure 80). Many of the wildfires that burned within the project area in the last 10 years were managed primarily for beneficial resource objectives (as opposed to being managed primarily for suppression objectives). These accounted for 38 wildfires totaling 126,310 acres burned within the project area. Other fires may have had some resource benefit management objectives as well, however the information needed to assess this is not readily available. The fire severity of the 38 wildfires managed primarily for resource benefit was mostly low and moderate.

[6] The USFS and the National Interagency Fire Center define 'large fires' as fires of at least 300 acres in size for grass or shrub fuels, or at least 100 acres in size in timber fuels (USDA 2014a). This analysis includes all fires that occurred from 2009 through 2018 and were at least 100 acres in size.

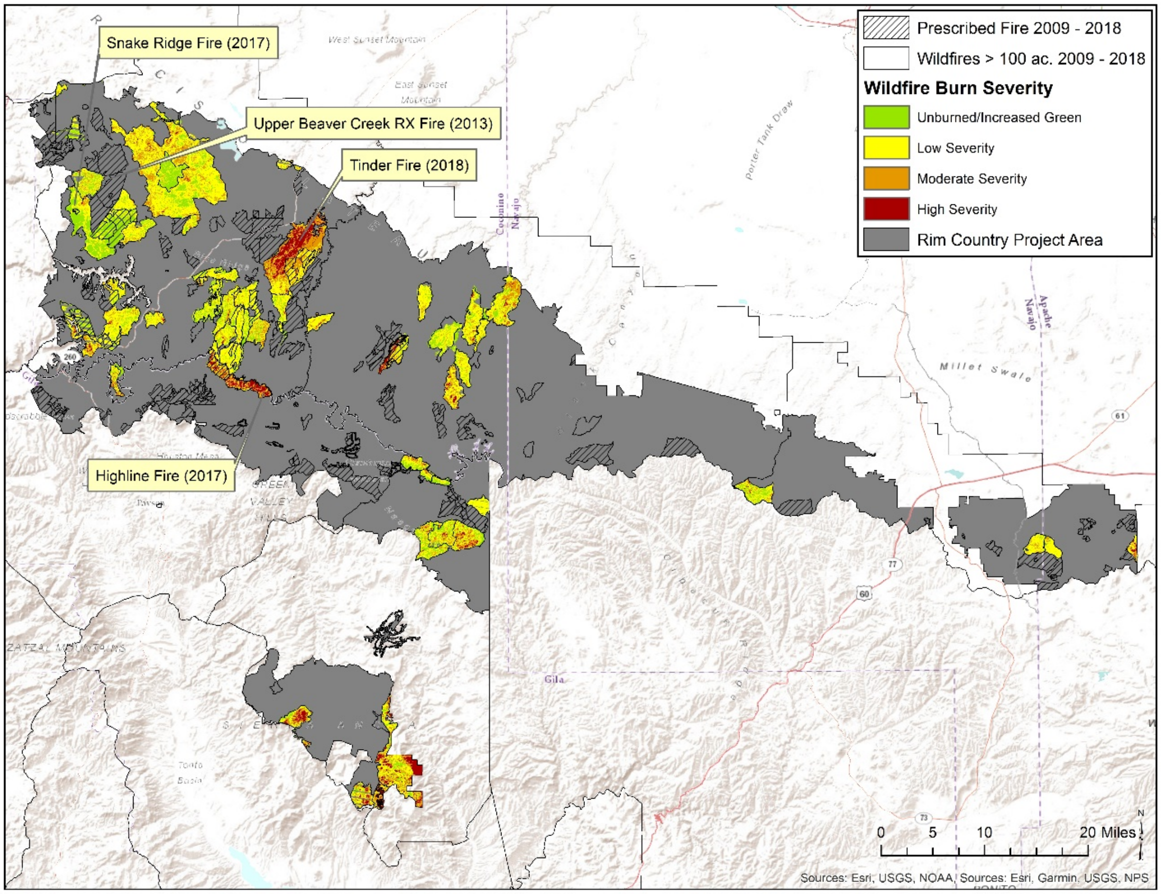

Figure 80: Recent Wildfire and Prescribed Fire (2009 – 2018) and the associated wildfire burn severity

However, high severity fire has continued to occur within the Rim Country area. In the past 10 years, approximately 12,193 acres burned at high severity within the project area. The Tinder fire (managed for suppression) burned with 27 percent (4,328 acres) high severity, and 33 homes were destroyed. The Highline fire (also managed for suppression) burned with 18 percent high severity. Post fire debris flows initiated in part from the Highline Fire claimed the lives of 10 people and caused significant damage to the watershed. These fires demonstrate some of the negative impacts associated with high severity fires.

Vegetation Management Activities

Within the cumulative effects analysis area, there were approximately 164,232 acres of mechanical thinning and approximately 259,661 acres of prescribed fire acres within the past 10 years (Table 45).

Table 45: Acres of past, present and reasonably foreseeable projects with cumulative effects for fire, fuels and air quality.

Treatment Type	Past Projects (approximate acres)	Current Projects (approximate acres)	Reasonably Foreseeable Projects (approximate acres)	Combined Past, Present and Reasonably Foreseeable Projects (approximate acres)
Mechanical Vegetation Management	164,232	417,551	124,434	*706,217*
Prescribed Fire	259,661	383,541	64,710	*707,912*
Other Activities*	51,072	40,379	93,147	*184,598*
Totals	**474,965**	**841,471**	**282,291**	***1,598,727***

*Other activities include but not limited to fuels chipping, range forage improvement or manipulation, range vegetation control, wildlife habitat improvement, tree encroachment control, tree release, fuels compaction, special products removal, insect control and prevention planting, fuel break creation, cultural site protection, scarification and seeding, pruning, and salvage.

These past activities have, and will continue to moderate potential wildfire effects for the cumulative effects analysis area. This was demonstrated by the Upper Beaver Creek prescribed fires completed in 2013. These treatments allowed for the 2017 Snake Ridge wildfire to be managed for beneficial resource objectives, and influenced the final fire perimeter. Objectives of these projects include fuels reduction, maintenance burning, recreating historic stand conditions in PJ (mixed severity), and reducing the risk of stand replacement fire and the rate of spread, intensity, and severity of wildfires that do occur.

In general, the past management actions have decreased the potential for active crown fire, crown fire initiation and high severity fire effects on the acres treated and/or burned by wildfire. Across the cumulative effects analysis area other projects have affected vegetation in similar ways to those described under this project's alternatives, though there are some variations in treatments, particularly for the older fuels treatments. Past mechanical and prescribed fire treatments have decreased the potential for crown fire by breaking up the vertical and horizontal continuity of canopy fuels. Prescribed fire and low severity wildfires further decreased the potential for crown fire, by removing additional ladder fuels, decreasing canopy bulk density, and raising canopy base height. Maintenance burning and wildfires decreased surface fuel loading in most areas burned, decreasing the potential intensity of subsequent fires in those locations.

Air Quality: Past treatments and wildfires have decreased the potential emissions by removing canopy fuels, mostly from thinning, but also some from wildfire and prescribed fire. Low to Moderate severity fire would have consumed surface fuels, further decreasing potential for emissions on about 205,587 acres. Where wildfires burned with high severity (~12,193 acres in and adjacent to the project area), fine canopy fuels (needles and small twigs) were consumed leaving tree stems and branches, some of which have fallen and are now Coarse Woody Debris which have the potential to smolder for days, or weeks.

Present and Reasonably Foreseeable Actions

Current, ongoing, and foreseeable projects within the Rim Country project area include 448,251 acres of prescribed fire and 541,985 acres of mechanical vegetation management (Table 19). Some of these projects are in the early stages of proposal development or are presently on hold, so their implementation is reasonably foreseeable but not assured. The acreages shown under mechanical vegetation management and fuels treatments are not all mutually exclusive. There are many acres on which proposed fuels treatments (mechanical and prescribed fire) overlap with proposed mechanical vegetation management treatments.

Alternative 1

Effects of the Alternative

Alternative 1 would continue to maintain 977,656 acres with increasing potential for high severity fire effects and behavior, though the effects would be mitigated to some degree by current and reasonably foreseeable projects, and any beneficial wildfires that may occur in the future. Alternative 1 would not contribute to improving the structure, composition, and patterns within the area proposed for treatment.

Effects of Other Actions

Fuel treatments have been, and continue to be implemented in WUI closest to major population centers, but much of the landscape is still vulnerable to undesirable fire behavior and effects, including changes in site productivity, loss of critical habitat, flooding, erosion, weed infestations, damaged infrastructure, and the longer term effects of having thousands of acres of dead trees nearby for decades.

Within the area considered for cumulative effects for fire ecology and air quality, other actions will contribute to some improvement in landscape conditions. However, these improvements would be much less than those predicted for the action alternatives. Improvements would be primarily localized, within individual project boundaries, and collectively do less to move the broader landscape towards desired conditions. Alternative 1 would lead to less spatial continuity between treatments when compared to the action alternatives. At the landscape scale, it would not put the ponderosa pine and associated vegetative systems on trajectories towards being resilient or sustainable.

Cumulative Effects

Under Alternative 1, the treatment area would continue develop unnatural densities and fuel loading, increasing the potential for undesirable fire behavior and effects when wildfires occur. When fires did occur, many would have potential for extreme fire behavior and could produce large areas of high severity fire effects. These impacts could extend well outside of the treatment area as fires that start within the proposed treatment area may pose difficulties for control and spread to adjacent lands. Many fires starting within the untreated project area would have potential to spread outside of the treatment area. Increased potential for extreme fire behavior would put lives, property, infrastructure, and natural resources at risk. Effects would also extend well beyond the perimeters of the fire, and would include such effects as flooding, debris flow, sedimentation, decreased water quality and quantity, decreased soil productivity, and other effects of fires burning out of their natural range of variation.

Fire Type

For those areas treated under the past, present and reasonably foreseeable actions, there would be a decrease in potential crown fire. However, the majority of the landscape would remain susceptible to crown fire and associated fire related impacts under Alternative 1.

Fire Hazard Index

Similar to fire type, reductions in fire hazard index are anticipated for areas treated under past, present and reasonably foreseeable actions. While beneficial, these reductions are not sufficient to mitigate the high fire hazard index ratings across the majority of the landscape.

Surface Fuels
Some reductions in surface fuels are anticipated, associated with the areas treated by past, present and reasonably foreseeable actions. However, for much of the cumulative effects analysis area, unnatural levels of surface fuels will continue to build up. When wildfires do occur in these areas of increased surface fuels, additional consumption and associated emissions are expected.

Air Quality & Smoke
Air quality would be unaffected by prescribed fire from the treatment area, however current and foreseeable activities will continue to produce smoke. Emissions from close to 450,000 acres of prescribed fire from current, ongoing, and reasonably foreseeable projects would be managed in compliance with regulations and requirements of the Arizona Department of Environmental Quality (ADEQ). Wildfires occurring in the untreated areas would produce more emissions in areas that were not treated than in areas that were treated, and could augment the effects of prescribed fires (from current and foreseeable projects) on air quality. Areas with potential for impact would be the Colorado River Airshed, the Little Colorado River Watershed, and the Verde River Watershed. Class 1 airsheds that could be affected include Grand Canyon National Park, Sycamore Canyon Wilderness Area.

Alternative 2

Effects of the Alternative
As described in the direct and indirect effects section, treatments proposed in Alternative 2 would move considerable acres toward desired conditions for fire behavior and associated fire effects across the project area.

Effects of Other Actions
Fuel treatments have been, and continue to be implemented in the WUI, closest to major population centers.

Within the area considered for cumulative effects for fire ecology and air quality, other actions will contribute to improvements in landscape conditions. Improvements include localized reductions in crown fire potential, decreases in fire hazard index values, and reduced levels of surface fuels.

Cumulative Effects
When considered with past wildfires, and past, ongoing, and reasonably foreseeable management activities, this alternative would augment the effects of proposed treatments at multiple scales, creating mosaics of potential fire behavior and effects, dominated by low severity fire. The proposed treatments would fill in most of the acres between past, current, ongoing, and foreseeable management activities, creating a more cohesive, contiguous, restored landscape across the project area.

Where past, present and foreseeable wildfires and treatments occur close to treatments proposed in the action alternatives, they serve to augment the moderating effect that the change in fuel structure is predicted to have on wildfires moving though the area by decreasing the acres where high severity fire effects are likely to occur. These combined activities also serve to augment the potential size and locations of burn units for the action alternatives because the moderated fire behavior in burned and/or thinned areas allow prescribed fire to be implemented with broader burn windows and higher intensity fire (if desired) while still meeting control and resource objectives.

Fire Type
Alternative 2 reduces crown fire potential under extreme fire weather conditions from 31 percent under

current conditions to 12 percent within areas proposed for treatment. This reduction, combined with the past, ongoing, and reasonably foreseeable management activities would cumulatively reduce the overall landscape susceptibility to crown fire. When added to other treatments in the cumulative effects area alternative 2 provides for greater connectivity of treated landscapes resulting and the largest overall reduction in crown fire potential as contrasted with alternative 3. As a result, under moderate burning conditions, the majority of the landscape is projected to support surface fire. These cumulative effects provide the biggest improvement of all alternatives in overall firefighter and public safety while allowing fire to play a more natural role across the landscape, and provide opportunities to manage fires for resource benefits across a broader landscape.

Fire Hazard Index

This alternative provides for a significant reduction in moderate to extreme fire hazard index (FHI) ratings, reducing the total area in these categories to 15 percent of the project area from 37 percent. When combined with past, ongoing, and reasonably foreseeable management activities, this alternative provides for additional improvements in FHI over the full cumulative effects analysis area.

Surface Fuels

Cumulative effects on surface fuels under alternative 2 provide for the greatest overall reduction in surface fuels. Cumulatively, this alternative will lead to a reduction in unnatural levels of surface fuels that have built up over time. When wildfires do occur in these areas of reduced surface fuels, consumption and associated emissions are expected to be lower than they would have been without the combined treatments.

Air Quality & Smoke

The cumulative effects under Alternative 2 include the greatest number of acres being treated with prescribed fire across the cumulative effects area. Cumulatively, this alternative combined with current and reasonably foreseeable activities will result in an annual average of more than 140,000 acres of prescribed fire (though annual amounts may vary considerably). The overall impacts from this amount of prescribed fire is expected to be more than those associated with alternatives 1 and 3. All prescribed fires would be implemented in compliance with ADEQ regulations and requirements as well as forest plan direction to meet legal standards and provide for public safety.

Emissions from prescribed fires proposed in Alternatives 2 would utilize many of the same burn windows that the nearly 450,000 acres of current, ongoing, and reasonably foreseeable prescribed fire projects would use. However, the increased acres of prescribed fire would allow more flexibility for implementation, and may make it possible to burn more acres at once with the same impacts to air quality.

Areas with potential for air quality impacts include the Colorado River Airshed, the Little Colorado River Watershed, and the Verde River Watershed. Class 1 airsheds that could be affected include Petrified Forest National Park, Sierra Anches Wilderness Area and Mazatzal Wilderness Area. As more acres are treated, there would be broader burn windows, potentially resulting in more days of prescribed fire and days of air quality impacts when added to prescribed burning occurring in the cumulative effects boundary.

Alternative 3

Effects of the Alternative

As described in the direct and indirect effects section, treatments proposed in Alternative 3 would move considerable acres toward desired conditions for fire behavior and associated fire effects across the project area.

Effects of Other Actions

Fuel treatments have been, and continue to be implemented in the WUI, closest to major population centers. Within the area considered for cumulative effects for fire ecology and air quality, other actions will contribute to improvements in landscape conditions. Improvements include localized reductions in crown fire potential, decreases in fire hazard index values, and reduced levels of surface fuels.

Cumulative Effects

Fire Type

Alternative 3 reduces crown fire potential under extreme fire weather conditions from 31 percent under current conditions to 18 percent within areas proposed for treatment. This reduction, when combined with the past, ongoing, and reasonably foreseeable management activities will serve to reduce the overall landscape susceptibility to crown fire. Cumulatively alternative 3 when combined with prescribed fire from other projects provides for less connectivity of treated landscapes, though portions of areas not proposed for treatment remain susceptible to crown fire. As with Alternative 2, under moderate burning conditions, the majority of the landscape is projected to support surface fire. The cumulative effects will improve overall firefighter and public safety while allowing fire to play a more natural role across the landscape, and provide opportunities to manage fires for resource benefits across a broader landscape, though to a lesser degree than alternative 2.

Fire Hazard Index

This alternative provides for a significant reduction in moderate to extreme FHI ratings, reducing the total area in these categories to 22 percent of the project area from 37 percent. When combined with past, ongoing, and reasonably foreseeable management activities, this alternative provides for additional improvements in FHI over the cumulative effects analysis area.

Surface Fuels

Cumulative effects on surface fuels under alternative 3 provide for considerable reduction in surface fuels. Cumulatively, this alternative will lead to a reduction in unnatural levels of surface fuels that have built up over time. However, areas left untreated will continue to accumulate unnatural fuel loading, and when wildfires do occur in these areas, elevated consumption and associated emissions are expected.

Air Quality & Smoke

Cumulatively, alternative 3 combined with current and reasonably foreseeable activities will result in an annual average of more than 97,000 acres of prescribed fire (though annual amounts may vary considerably). The overall impacts from this amount of prescribed fire is expected to be nearly a third less than those associated with alternative 2, but more than alternative 1.

Additionally, the potential for higher overall emissions associated with wildfires burning in areas not identified for treatment under Alternative 3 will result in more emissions in these areas than alternative 2. All prescribed fires would be implemented in compliance with ADEQ regulations and requirements as well as forest plan direction to meet legal standards and provide for public safety. Emissions from prescribed fires proposed in Alternatives 3 would utilize many of the same burn windows that the nearly 450,000 acres of current, ongoing, and reasonably foreseeable prescribed fire projects would use over the next 10 years. However, the increased acres of prescribed fire would allow more flexibility for implementation, and may make it possible to burn more acres at once with the same impacts.

Areas with potential for impact include the Colorado River Airshed, the Little Colorado River Watershed, and the Verde River Watershed. Class 1 airsheds that could be affected include Petrified Forest National Park, Sierra Anches Wilderness Area and Mazatzal Wilderness Area. As more acres are treated, there would be broader burn windows, potentially resulting in more days of prescribed fire and days of air quality impacts when added to prescribed burning occurring in the cumulative effects boundary

Climate Change

All Alternatives

Climate change is expected to result in extreme weather conditions, with more extreme droughts and higher temperatures, making conditions for undesirable fire and insect outbreaks even more prevalent in the western United States. As a part of current, ongoing, and reasonably foreseeable management actions, there would be prescribed fire and mechanical thinning adjacent to, or within, the 4FRI Rim Country project area. Thinning, prescribed burning, or allowing wildfires that produce only low to moderate-severity effects reduces on-site carbon stocks and releases carbon into the atmosphere at a lower rate than high-severity fire.

Carbon sequestration is an important dynamic of climate change that has been and continues to be affected by current and past forest management. Fire suppression practices have changed the dynamics of fire in ponderosa pine forests across the southwest, resulting in greater fuel-loads and increased risk of uncharacteristic fire. Although current conditions, with dense forest stands can sequester more carbon than open forests, shrublands, or grasslands, it is not a stable state. These forests are prone to increasingly large, high severity wildfires, which release a pulse of carbon emissions, shifting carbon storage from live trees to standing dead trees and woody debris (North et al. 2009). Kolb et al. (2007) have shown that biomass and carbon may fail to recover; the Horseshoe Fire was still a net carbon source fifteen years after the fire. Savage and Mast (2005) showed that these conditions can persist for decades.

High severity fire in ponderosa pine forests releases large quantities of CO_2 to the atmosphere. The emissions below are associated with ponderosa within an existing, healthy fire regime. Far more carbon is stored in the healthy ponderosa pine forest than the area recovering from a high severity fire.

Both thinning and prescribed burning would help to mitigate the negative effects of stand replacing fire in dry, dense forests, by consuming less biomass and releasing less carbon into the atmosphere (Finkral and Evans 2008, Wiedinmyer and Hurteau 2010). They found that while the treatment initially produced a 30 percent reduction in the carbon held in trees, it significantly reduced the threat of an active crown fire, which they predicted would kill all the trees and release 3.7 tons of carbon per acre in any untreated areas. Such findings are especially important when one considers that climate change is expected to cause conditions that support uncharacteristic fire and insect outbreaks to become even more prevalent in the western United States. Thinning, prescribed burning, or allowing wildfires that produce only low to moderate severity effects reduces on-site carbon stocks and releases carbon into the atmosphere at a lower rate than high severity fire.

Heritage Resources

A summary of the heritage resource analysis is presented here and the complete heritage specialist report (Hangan 2018) is incorporated by reference.

Affected Environment

Within the Rim Country project area, cultural resources range temporally from prehistoric times through the historic period and into modern times. Prehistoric sites can include rock art, cliff dwellings, pithouses, multiple room pueblos and artifact scatters. Historic resources may consist of logging railroad grades, trails and historic roads, cabins and homesteads, Forest Service administrative sites, Basque sheep camps, mining camps, Civilian Conservation Corps sites, and Native American shelters such as sweat lodges and brush shelters. Cultural resources also include Native American traditional use areas and places known as Traditional Cultural Properties. These hold a central and important place in Native American culture.

The existing condition for cultural resources is determined by the number of existing heritage inventories within the analysis area, in addition to the amount and/or types of resources, and cultural periods represented by those resources, that have been identified within the boundaries of the EIS. Table 46 was generated by the Apache-Sitgreaves and Coconino National Forests using their heritage GIS databases, while the Tonto used their hard copy heritage atlases.

Table 46. Cultural resource sites and surveys

Forest Name	Acres Previous Survey	Cultural Resources Recorded	National Register Listed Sites	NR eligible Sites	Unevaluated Sites	Site Previously Evaluated Ineligible
Apache-Sitgreaves	104,474	3,012	6	795	2,026	57
Coconino	97,900	946	2	148	774	22
Tonto	29,226	1100	2	388	621	91

Apache-Sitgreaves National Forests

The Rim Country EIS Area of Potential Effect includes 539,942 acres of the Apache-Sitgreaves National Forests, 401,911 acres on the Black Mesa Ranger District (65 percent of the district) and 138,031 acres on the Lakeside Ranger District (51 percent of the district). According to current geographic information systems (GIS) data, forest archaeologists have surveyed 90,929 acres, approximately 17percent of the 539,942 acres in the Rim Country project area.

Three thousand and twelve (3,012) cultural resources have been recorded, 1,694 on the Black Mesa Ranger District and 1,318 on the Lakeside Ranger District, of which six are listed on the National Register of Historic Places, 795 were determined eligible for inclusion on the National Register, 2,026 are unevaluated for eligibility, and 27 have been determined not eligible for inclusion on the National Register. Most of the sites recorded are prehistoric or protohistoric in nature (84 percent), followed by historic sites (12 percent), 74 sites of unknown affiliation (2½ percent), and multi-component sites with historic and prehistoric artifacts/features (1½ percent). Site types represent a full range of human occupation, from Paleoindian sites of the Pleistocene to a wide variety of historic period sites dating to 50 or more years ago.

Coconino National Forest

The Rim Country EIS Area of Potential Effect includes 398,860 acres of the Coconino National Forest, 389,482 acres on the Mogollon Rim Ranger District and 9,378 acres on the Red Rock Ranger District. Within this area, forest archaeologists have surveyed 97,900 acres, approximately 25 percent of the 398,860 acres in the Rim Country project area. Archaeologists have identified 946 cultural resources, of which two are listed on the National Register of Historic Places, 148 were determined eligible for inclusion on the National Register, 774 are unevaluated for eligibility, and 22 have been determined not eligible for inclusion on the National Register.

Most of the sites recorded on the Coconino are prehistoric in nature (78 percent), followed by historic sites (20 percent), multi-component sites with historic and prehistoric artifacts/features (16 percent), and four sites of unknown affiliation. The majority of the prehistoric sites are lithic scatters (47 percent) and scatters with lithic artifacts and ceramics (21 percent). Other prehistoric sites include sites with house features: field houses, pueblos, pithouses, cliff dwellings, or other house features (20 percent), caves/rockshelters/cavates (3 percent), agricultural fields (3 percent), and rock art sites (4 percent). The 189 historic sites include those associated with national forest management (21 percent), logging or sawmills (7 percent), ranching (47 percent), historic trails or wagon roads (6 percent), mining (3 percent), military (3 percent), historic burials (3 percent), and trash dumps that may be related to one or several of these historic activities (10 percent).

Tonto National Forest

The Rim Country EIS Area of Potential Effect includes 290,090 acres on the Payson and Pleasant Valley Ranger Districts of the Tonto National Forest. Within this area, forest archaeologists have surveyed 29,226 acres, approximately 10 percent of the 290,090 acres in the Rim Country project area. Archaeologists have identified 1100 cultural resources, of which two are listed on the National Register of Historic Places, 388 were determined eligible for inclusion on the National Register, 621 are unevaluated for eligibility, and 91 have been determined not eligible for Assumptions and Methodology

Assumptions and Methodology

The primary assumption for this effects analysis is that the removal of fuel from archaeological sites and improving or decommissioning roads is a benefit to cultural resources. These activities could protect cultural resources from the effects of extremely hot, highly destructive wildfires by removing fuel from around and off of archaeological sites. Improving or decommissioning roads could protect archaeological sites by removing roads that go through sensitive sites. Improving rough, impassible roads could reduce the threats to archaeological sites from off-road driving. This would also encourage drivers to remain on roads rather than drive cross-country to avoid bad spots in roads. However, the methods for accomplishing these tasks, such as mechanical thinning or ripping of roads, also has the potential to adversely affect cultural resources.

The secondary assumption is that cultural resources would be present at the proposed spring, riparian, or stream restoration locations. Cultural resources are frequently found in association with water sources such as springs, streams, and riparian areas. Water sources would have been exploited prehistorically and during historic periods. A reliable spring, for example, would likely have been developed to supply stock grazing, logging operations, or farming.

The final assumption is that all activities proposed with the Rim Country EIS would meet the criteria of a No Adverse Effect determination as defined in the Programmatic Agreement and/or 36 CFR 800.6 where appropriate.

In consultation with the AZ SHPO, the forests are going to rely on multiple guidance documents and strategies to assist in reaching a No Adverse Effect determination. The primary guidance would be Appendix J of the Programmatic Agreement. Appendix J of that agreement outlines the consultation protocols and strategies for implementing large-scale fuels reduction, vegetation treatment, and habitat improvement projects.

To supplement Appendix J, in consultation with the AZ SHPO and tribes, the Rim Country forests created a sample survey strategy specifically for vegetation projects that would involve mechanical treatments (Morgan et al 2017). Appendix J of the Programmatic Agreement provides guidance for mechanical treatment. However, it does not distinguish between the various types of mechanical treatment options, for example, feller-buncher versus agra-ax, nor does it take into account existing site inventory data or identified high and low site densities areas. A model was created using terrestrial ecological unit strata and known site densities within the project area. The model, amount of existing inventory within a task area and the type of proposed mechanical treatment would all be taken into account when determining the amount of inventory necessary and any standard mitigation measures that need to be implemented to meet the criteria of No Adverse Effect.

The Programmatic Agreement would guide the analysis for the remaining activities proposed in the Rim Country EIS. The one exception would be road improvement and decommissioning. Some Forest roads are known to cross archaeological sites and they often have exposed artifacts and cultural features in the road beds. Improving or decommissioning roads usually involves some level of mechanical work such as grading or ripping road beds. The forests, in consultation with the AZ SHPO and tribes, developed a road plating protocol. This protocol outlines procedures for "plating" or covering the portions of sites within road beds that have remaining features or intact cultural deposits. This would help to protect intact cultural remains in the roads from blading or other types of maintenance or decommissioning activities.

Phased Section 106 Compliance

Because of the size of the undertaking, implementation would be phased over several years. Appendix J, reviewed by the AZ, NM, TX and OK SHPOs, the ACHP, and tribes, allows for the phasing of the Section 106 compliance. Appendix J of the Programmatic Agreement and the Rim Country Sampling Strategy, developed in consultation with tribes and the AZ SHPO, describes the methods to be used to achieve a No Adverse Effect determination for the Rim County analysis as a whole, while providing a strategy for a phased Section 106 evaluation for individual task orders.

Individual task orders, or undertakings, would be inventoried when each specific project area is identified. A Section 106 report would be produced for each proposed individual undertaking, and all consultation with the AZ SHPO and appropriate tribes would be completed prior to implementing the task order.

Environmental Consequences

Alternative 1 – No Action

Under Alternative 1, existing fuels in and around archaeological sites would continue to increase. This could result in more frequent and intense wildfires which could result in site and artifact damage such as spalling of rock art and cracking of artifacts. Fire suppression actions, particularly bulldozer operations, could damage or completely destroy surface and subsurface (pit houses/kivas) archaeological sites, resulting in the loss of those resources and their research potential.

Soil erosion due to uncharacteristic wildfires could have both direct and indirect effects on heritage resources. Rain and snow melt could cause channels to form within denuded sites, or mud slides from nearby slopes could deposit soil and debris within site boundaries, leading to the loss of data potential and the characteristics that would make a heritage property eligible for the National Register of Historic Places.

Archaeological sites located within open grass lands would be affected by an increased number of trees growing inside the site boundaries. The trees and their root systems might displace surface and subsurface artifacts and features. Also the trees would increase the amount of fuel on the sites. This might result in effects from intense wildfires.

Forest system roads that cross archaeological sites would continue to affect the sites by degrading cultural deposits and features within road beds located inside site boundaries. Also, when roads are not well maintained, users may drive off existing roads to avoid "bad spots" and could affect cultural sites adjacent to the roads.

No action might also result in the reduction over time of pre-European settlement-adapted native plants, some of which have been collected since historic times by Native Americans for food and medicine. Additionally, springs, seeps, and riparian areas are important locations to Native Americans and other members of the public, and increasingly overstocked forests might have some effects on those historic water sources.

Effects Common to Both Action Alternatives

Each of the alternatives recommends a substantial amount of ground disturbance, particularly mechanical treatments as part of thinning trees, grassland restoration, blading in new temporary roads, maintaining existing roads, or decommissioning roads. Other activities such as stream and riparian restoration, and the installation of barriers around springs, aspen, and other native trees may also include-ground disturbing activities. Riparian areas and water sources like streams and springs tend to be locations where the presence of cultural resources can be reliably predicted. All of these activities have the potential to adversely affect cultural resources. Effects could include rutting, erosion, dislocation, or breakage of artifacts and features, and destruction of sites and site stratigraphy.

Prescribed burning also has the potential to affect sites. If the burning is low to moderate in heat intensity, and there is little fuel on the sites, most sites located inside the project area would be minimally affected, if at all, with the exception of sites that include wood elements or rock art. Sites within the project area with a significant amount of fuel in a prescribed burn area could be affected by heat damage in the same manner as a wildfire if the fuel is not removed prior to burning. Effects from heat damage would include breaking, pocking, and spalling of ground stone tools and architectural features. Excessive heat could alter obsidian hydration rinds, destroying their dating potential and the associated loss of scientific information. Effects on structural components such as rock walls or rock faces include discoloration, cracking, and spalling, making the rocks susceptible to accelerated deterioration. There is also the potential for effects from soil erosion due to the removal of vegetation. Rain and snow melt, for example, could cause channels to form within denuded sites. Mud slides from nearby slopes could deposit soil and debris inside site boundaries, leading to the loss of data potential and the characteristics that would make a heritage property eligible for the National Register of Historic Places. The majority of the effects listed above can be mitigated through project design, avoidance, removing fuel from sites prior to project implementation, and implementing site protection measures (see Appendix C).

Thinning and prescribed burning should reduce unnatural fuel loading around and inside the boundary of National Register listed or eligible heritage resources. Uncharacteristic fire behavior should also be reduced by these treatments, which would help to prevent extensive heat damage from future wildfires. There would be less need for fire suppression activities during a wildfire, and consequently less of a threat from ground-disturbing activities, such as bulldozer fire-line construction.

Initial reduction of heavy fuels may lead to an increase in site visibility, public visitation, and possible vandalism. Those issues are mitigated through management actions that include project-specific as well as long-term monitoring. Initial entry prescribed burns should be periodically revisited and burned to reduce natural fuel accumulations, and archaeological site monitoring is part of that process. Road decommissioning can also assist in limiting access to some archaeological sites, thus minimizing post-burn visibility and visitation issues at those sites.

The proposed temporary road construction, road maintenance, and road decommissioning do have the potential to affect cultural resources. The Programmatic Agreement includes mitigation measures that would help protect cultural resources affected by system roads identified for maintenance or decommission. The locations of temporary roads would be inventoried prior to implementation and any potential effects to sites would be mitigated through avoidance or project redesign. Decommissioning activities, if contained within the road beds and not inside site boundaries, should have no effects on cultural resources. In those cases where road maintenance or decommissioning might occur within National Register listed or eligible cultural resources, a site plating strategy should be used that has been developed in consultation with the AZ SHPO and tribes7. The protocol includes mitigation measures to protect any existing cultural deposits or features present within the road beds or along road cuts.

Restoration activities for grasslands, riparian areas, and streams do have the potential to effect cultural resources. Grasslands tend to contain low densities of archaeological sites. Some restoration activities, such as the use of an agra-ax to remove encroaching trees, though a mechanical treatment, are known to disturb little of the ground surface. Therefore grassland restoration activities are less likely to adversely affect cultural resources. Where sites are present, mitigation measures listed in the Programmatic Agreement and design features in Appendix C would be implemented.

Springs, streams, and riparian areas are known to be very sensitive for the presence of cultural sites and culturally important plants. Restoration activities that are highly ground-disturbing would affect cultural resources. The Programmatic Agreement lists mitigation measures that should be implemented to minimize effects on cultural sites.

Project implementation may affect some Native American uses as tribal members commonly access forest lands for ceremonial activities and to gather forest products. Access concerns can be addressed through on-going consultation between the Forest Service and Native American groups.

There is the possibility that cultural resources would be discovered during project implementation. These inadvertent discoveries would be handled, in consultation with AZ SHPO and tribes, following the guidance in Appendix J of the PA and 36 C.F.R 800.12., if appropriate.

Effects Unique to Each Action Alternative

The action alternatives propose essentially the same activities, ranging from various mechanical treatments, comprehensive restoration, and various types of road work. The major differences involve the amount of each activity being proposed. From a cultural resources stand point, there are no effects that are unique or different between the alternatives. Effects on cultural resources are highly dependent upon the proposed activity, its location, and the likelihood of the presence or absence of cultural resources in the proposed treatment area. Therefore, mechanically thinning *889,340 acres versus *483,160 acres only matters in that fewer acres proposed for mechanical treatment means less of a threat of effects on cultural resources from this activity. However, it also means less fuel removed, thus less protection to cultural resources from the effects of high intensity wildfires.

Effects from Rock Pit Use and Expansion

Approximately nine existing rock pits on the Coconino National Forest are being proposed for use within the Rim Country project area. On the Apache-Sitgreaves National Forests, 11 sites are proposed for use.

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7 The region is in the process of working on adding this strategy as a protocol to the R3 PA. Until that time, AZ SHPO agreed that this plating strategy can be used within the 4FRI Rim Country area.

The rock pits would be used as a source of gravel for various road maintenance activities. Their access roads might undergo some level of maintenance and the pits might be expanded in various directions to a maximum of 500 feet, where needed to increase their capacity to yield material. The rock pit locations on the Coconino were evaluated for Section 106 as part of the Rock Pits EA (USDA 2016). Unlike the pits on the Coconino, the rock pits on the Apache-Sitgreaves have not been evaluated for Section 106 compliance beyond their current operations. According to the forest's cultural resource database, Carr Lake, Brookbank, Borrow, and Cottonwoods Wash pits all have cultural resources that would need to be mitigated before and expansion of the pits.

Rock pit operations and expansions have the potential to affect cultural resource sites adjacent to the rock pits and their access road locations. Erosion by mass wastage, slope wash, and wind over many years can strip cultural deposits from archaeological sites, remove or displace artifacts, and undermine historical structures. Ground disturbances adjacent to cultural resource sites may accelerate erosion by damaging vegetation, loosening stable soil surfaces, or compacting soils, and thereby promote surface runoff. Vehicle tracks tend to channel surface runoff, causing down-cutting and increased soil erosion. These effects are expected to be avoided at cultural sites near rock pits through pit expansion design and avoidance measures such as erecting temporary fences around sites during periods of operation.

It is possible that increased truck traffic to and from proposed rock pits could result in indirect erosion effects on a small number of sites that occur adjacent to access roads. Keeping these roads well maintained would be expected to limit these effects.

The risk of unauthorized collection of artifacts would increase due to the presence of project personnel in areas where the locations of heritage resource sites are clearly marked. Unauthorized removal of materials from heritage resource sites could result in the loss of objects with cultural importance to Native American groups, or of artifacts needed to determine the age and nature of the occupation at prehistoric sites. This would be mitigated by requiring that sites identified near the pit operation areas are recorded in detail, then monitored after the operations are completed.

Effects from Use of In-woods Processing and Storage Sites

Twelve locations have been identified as potential processing and storage areas within the Rim Country project area on the Coconino and Tonto National Forests.

The storage and processing areas located on the Coconino National Forest are within the Cragin Watershed Protection project area. These areas were assessed as part of the Cragin heritage evaluation. Mitigation measures and design features for the Cragin Environmental Assessment parallel those listed in the Programmatic Agreement and Appendix C of this Rim Country EIS and would be implemented prior to project implementation. If the proposed processing and storage areas are selected for use, the Mogollon Rim Ranger District archaeologist would review the existing inventory for that location and would ensure that mitigation measures for the Cragin Project are implemented, if needed.

The potential locations on the Tonto National Forest would likely be utilized for task orders or contracts in those areas. The evaluation for all of the processing and storage locations would follow the processes outlined in the design features in Appendix C. Otherwise the guidance within the Programmatic Agreement would be used. Proposed mitigation measures would be implemented prior to the areas being used. With the implementation of standard mitigation measures and design features, there should be no adverse effects on cultural resources due to the use of these locations as storage and processing areas.

Effects from Forest Plan Amendment(s)

Three plan amendments were added to the Tonto National Forest Plan. They removed language restricting mechanical equipment on slopes of over 40 percent, amended Plan language and components to align with the Mexican Spotted Owl Recovery Plan, and redefined the treatment for ponderosa pine vegetation types. Of these three amendments, removing restrictions for mechanical equipment on slopes of less than 40 percent has the most potential to affect cultural resources and the methods for conducting Section 106 analysis.

Sensitive cultural resources such as rock art and rock shelters tend to be located on 40 percent or greater slopes of small hills, rock out-croppings and mountain slopes. However, because steeps slopes are typically not treated mechanically, Appendix J includes provisions that would allow for exempting slopes 40 percent or greater from intensive archaeological inventory. The Rim Country alternatives will include treatment of slopes up to 40 percent. This increases the likelihood of impacts to the types of cultural resources found in those locations. It also means that the archaeological analysis will need to include an intensive inventory of the steep slope treatment locations.

Cumulative Effects

The cumulative effects analysis area is the Area of Potential Effect for the Rim Country EIS.

Alternative 1 – No Action

If this proposed large scale, landscape level forest health project is not implemented, there would still be some serious cumulative effects on heritage resources. High intensity wildfires and the construction of fire breaks using bulldozers during a wildfire could severely damage sites. Wildfires could also sterilize the soil or completely remove ground fuels, making the sites vulnerable to soil erosion. Also, because sites are more visible after a fire, they are much more susceptible to vandalism. Soil erosion from dry channels that are within or adjacent to sites could continue to affect a site's cultural stratigraphy and displace much cultural material. Roads through sites would continue to degrade cultural deposits and features. Trees would continue to encroach into grasslands and displace artifacts and cultural deposits within sites.

Effects Common to Both Action Alternatives

Cumulative effects from mechanical treatments, temporary road construction, and other ground-disturbing activities, as well as effects caused by prescribed burning, would be mitigated using site protection measures identified in Appendix C, Appendix J of the Programmatic Agreement, the Rim Country Sample Survey Strategy, and the Site Plating Strategy. These include archaeological monitors during mechanical activities, keeping ground-disturbing activities out of sites by flagging and avoiding the sites, and post prescribed burn site monitoring to assess the effects of the low-intensity burns. Covering cultural deposits and features in road beds within cultural sites prior to maintenance activities or during decommissioning would protect buried cultural deposits and features. Also, well-maintained roads would encourage the public to remain on roads and deter cross-country travel which could damage sites located near roads. Because all ground-disturbing and prescribed fire undertakings go through the Section 106 review process, and identified potential effects would be mitigated, the overall cumulative effects from these undertakings should be minimal. Therefore, there should be few cumulative effects on cultural resources as a result of the activities proposed for the Rim Country Project.

There is the possibility of cumulative effects from archaeological site vandalism that results from increased visibility once the project is implemented. However, the management practice of implementing low to moderate-intensity prescribed fire typically does not sterilize soil or completely remove ground fuels, as does a high-intensity wildfire. Low-intensity fires also tend to leave some trees in place that would eventually cover the surface with a recurring needle cast. Sites are also periodically monitored both during project implementation, as well as for NHPA Section 110 purposes, by agency and volunteer personnel. Proposed road closures would also reduce public access to some of these areas.

The likelihood of erosion on cultural resources is also minimal. Reducing fuel loads and implementing low to moderate-intensity prescribed fires does not cause soil sterilization or hydrophobic soils like high-intensity wildfires. As noted previously, low-intensity prescribed fires leave some vegetation in place and re-vegetation occurs soon afterwards if soils are not sterilized. However, as implementation occurs, archaeologists would monitor for erosion concerns, examining sites in the project areas, especially focused on slopes, drainages, and other high probability areas where cultural resources maybe present.

The proposed restoration activities in grasslands, riparian, streams, and seeps would also have a very limited ability to cause cumulative effects. All of these activities can easily be modified to minimize effects on cultural resources through avoidance or prescription modification. In the case of grasslands, the physical removal of encroaching trees and other fuels would have the added benefit of protecting sites from the effects of wildfire.

Socio-Economics

A summary of the Socioeconomic Report is presented here. The complete specialist report (Jaworski 2019) is incorporated by reference. The analysis describes the current conditions and trends related to the social and economic environment of the planning area, including: population and demographic changes, potential environmental justice populations, and employment and income conditions.

Affected Environment

Population Growth

The planning area counties are home to approximately 530,000 people, which is approximately eight percent of Arizona's population (U.S. Census Bureau 2017). Table 47 displays annual population estimates for the planning area counties and the state.

Table 47. Population Estimates 2010 to 2016

Location	2010	2011	2012	2013	2014	2015	2016
Coconino County	134,624	134,186	135,999	136,641	137,695	139,076	140,908
Gila County	53,539	53,486	53,036	53,039	53,124	53,138	53,556
Navajo County	107,714	107,735	107,037	107,443	108,178	108,363	110,026
Yavapai County	211,139	211,138	212,350	215,027	218,405	221,584	225,562
Arizona	6,408,312	6,467,163	6,549,634	6,624,617	6,719,993	6,817,565	6,931,071

Source: U.S. Census Bureau, Population Estimates, 2017

Arizona was among the fastest growing states between 2010 and 2016, over which period Arizona grew 8.2 percent (U.S. Census Bureau 2017). The counties in the planning area grew more slowly over this period, ranging from 6.8 percent population growth in Yavapai County to no growth in Gila County (U.S. Census Bureau 2017).

Population growth in the planning area may interact with forest management activities. For example, population growth may increase the size of the wildland-urban interface. Wildland-urban interface growth can affect ecological integrity, wildfire suppression costs, and the number of people exposed to smoke emissions.

Wildfire Costs

In 2015 and 2016, federal wildland fire suppression cost approximately $2 billion annually, $1.7 billion of which was spent by the USFS (NIFC 2017). That is a nearly 300 percent increase in cost (inflation adjusted) since 1985 (NIFC 2017). Much of the cost increase has been attributed to the further development of the wildland-urban interface, climate change, and management of forests (suppression, prescribed burns, etc.). Past large wildfires in and around the Rim Country project area have cost tens of millions of dollars to fight. The 2005 Cave Creek Complex Fire alone cost the Forest Service approximately $18 million to fight. In 2016, the Forest Service spent $12 million on the Juniper and Fulton Fires (N. Hale, personal communication, June 7, 2017).

Between 1995 and 2015, the percentage of the Forest Service budget spent on fire expanded from 16 to 52 percent (USFS 2015). Furthermore, suppression costs account for only a fraction of the total cost of wildfires. Wildfires often entail costs associated with rehabilitation, lost property, decreased business revenue, and human health effects. The Western Forestry Leadership Coalition estimates that total wildfire-related expenses, when accounting for a variety of direct and indirect costs, range from two to thirty times the reported suppression expenditures (WFLC 2010).

The rising cost of federal wildland fire operations has caused a shift of agency expenditures from other mission critical activities (for example, restoration, research, and recreation) toward firefighting and fire management (USFS 2015). Reduced funding for recreation, vegetation and watershed management, wildlife and fisheries habitat management, and other non-fire activities limits the ability of the Forest Service to contribute to improvements in ecosystem services and quality of life in nearby communities (USFS 2015). For example, between fiscal years 2014 and 2015, the agency’s fire suppression expenditures increased by $115 million while non-fire programs were reduced by the same amount (USFS 2015). Climate change and continued population growth in the wildland-urban interface are expected to contribute to rising fire suppression costs.

Beginning in fiscal year 2020 through fiscal year 2027, the Forest Service fire suppression spending from its regular budget would be capped at just over $1 billion and fire suppression costs in excess of this amount would be funded through an emergency wildland firefighting account rather than through borrowing from other Forest Service program areas (USDA 2018).

Forest Products Industry

Table 48 shows the number of employees in four forestry-related sectors in the project area. According to the IMPLAN data, the counties in the project area currently have few jobs in forestry-related sectors. Navajo County has the largest numbers of employees in commercial logging, biomass generation, and sawmills. Gila County has the fewest employees in these sectors. The four counties in the project area have approximately 30 percent of commercial logging and sawmill employees and seven percent of wood product manufacturing employees in the state. As of 2015, the only biomass power generation facility in the state was in Navajo County (IMPLAN 2015).

Table 48. Employment in Forestry-Related Sectors, 2015

Location	Commercial Logging	Biomass Power Generation	Sawmills	Wood Product Manufacturing
Coconino County	17.6	0.0	2.4	137.1
Gila County	8.5	0.0	0.0	60
Navajo County	42.0	0.5	39.8	146.6
Yavapai County	41.9	0.0	4.2	19.2
Arizona	379.7	0.5	162.5	5,539.8

Source: IMPLAN, 2015

In terms of employment, only Navajo County is more specialized in forestry-related sectors than the nation overall (Headwaters Economics 2017). These data indicate where existing capacity – in terms of infrastructure and skilled labor – to implement 4FRI activities may exist in the project area.

The vast majority (97 percent) of timber harvested in Arizona is processed in the state, though very little timber from other states flows into Arizona for processing (Sorenson et al. 2016). In 2012, there were 25 active wood product manufacturers, including sawmills, house log and viga manufacturers, bioenergy facilities, and other plants (Sorenson et al. 2016). These facilities are concentrated near the Rim Country project area. The number of primary wood processing facilities in Arizona increased by approximately 50 percent between 2007 and 2012 (Sorenson et al. 2016). Proximate wood processing facilities are essential for forest restoration activities, since transportation costs can erode the financial feasibility of removing small diameter and low value forest products.

4FRI Phase One Implementation

Implementation of phase one of 4FRI contributed jobs and labor income to the regional area. This is important because it sets the stage for future implementation activities under the Rim Country 4FRI. This section will demonstrate how the social and economic affected environment has changed since phase one was implemented in FY 2017.

Implementation activities for phase one were assessed using primary employment data gathered via surveys of wood contractors in the area. In FY 2017, the economic activities related to implementation of 4FRI phase one were 12,000 acres mechanically thinned and the removal of about 400,000 green tons of sawlogs and biomass for processing. These activities generated almost 1,000 full and part-time jobs and $50 million in labor income in FY 2017 in Apache, Coconino, Gila, Greenlee, and Navajo counties in northern Arizona (Hjerpe 2018).

While these economic contributions from phase one 4FRI activities are substantial, the growth in contributions has been limited and are less than original project objectives (Hjerpe 2018). Hjerpe (2018) also found that “the main barrier to ramping up 4FRI mechanical thinning accomplishments is the lack of profitability in thinning and processing small diameter ponderosa pine.” Ways to boost the economic contributions from 4FRI activities include “to increase the scale of acres treated, which would result in greater thinning and wood utilization employment” and “to decrease the amount of contributions leaked from the region” (Hjerpe 2018). Contributions leave the region when there is inadequate infrastructure to process the harvested wood in the region. Any regional response to these barriers and solutions would affect how wood is processed and how the resulting economic contributions accrue to the region under this current Rim Country 4FRI.

Ecosystem Services

The economic value of Forest Service resources, uses, and management is not entirely captured in market transactions. Much of the value of national forests is "non-market" in nature – meaning that many of the benefits that forests provide to humans do not have a price. The lack of a price, however, should not be conflated with an absence of value. Indeed, non-market values from forests provide economic benefits to adjacent communities and forest visitors.

Ecosystem services are "components of nature, directly enjoyed, consumed, or used to yield human well-being" (Boyd and Banzhaf 2007). Healthy forests provide numerous ecosystem services, including clean water and air, biodiversity, forest products, and many other goods and services.

Wildfire has the potential to reduce ecosystem service values through: (1) destruction of wildlife habitat, (2) water quality and watershed impacts, (3) damage to cultural and archaeological sites, and (4) soil erosion and impacts to water quality (Morton et al. 2003). Furthermore, post-fire effects, such as flooding, can threaten life and property and further degrade ecosystem services.

Socioeconomic Vulnerability

A social vulnerability index for all counties in the Southwestern Region of the Forest Service reveals that Navajo County has among the lowest adaptive capacity of counties in the region. Households in Navajo County are likely to have fewer resources available to them. In contrast, Coconino and Yavapai counties have among the highest adaptive capacity of counties in the region. Households in these counties are likely to have many more resources available to them (Hand et al., forthcoming). Displacement due to wildfire, for instance, may be more difficult for households in Navajo County than households in Coconino and Yavapai counties. These findings reveal a great deal of socioeconomic diversity across the planning area.

Environmental Justice

In 1994, President Clinton issued Executive Order 12898. This order directs federal agencies to consider the human health and environmental conditions in minority and low-income communities. The purpose of Executive Order 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations (Executive Office of the President 1994).

Environmental justice is the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The goal of environmental justice is for Federal agency decision-makers to identify impacts that are disproportionately high and adverse with respect to minority and low-income populations and identify alternatives that would avoid or mitigate those impacts.

Coconino, Gila, and Navajo counties have high concentrations of American Indian residents, due to the large share of tribal lands in these three counties. The majority of land in Navajo County is tribal land. Yavapai County also contains tribal lands, though the areas are quite small. [8] As a result, environmental justice issues are more likely to occur in Coconino, Gila, and Navajo counties than Yavapai County.

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8 Coconino County contains all or part of the Navajo Indian Reservation, Hualapai Indian Reservation, Hopi Indian Reservation, Havasupai Indian Reservation, and Kaibab Indian Reservation. Navajo County contains part of the Navajo Indian Reservation, Hopi Indian Reservation, and Fort Apache Indian Reservation. Gila County contains part of the Fort Apache Indian Reservation, the Tonto Apache Reservation, and the San Carlos Indian Reservation. Yavapai County contains all or part of the Yavapai-Prescott Indian Reservation, the Yavapai-Apache Nation Indian Reservation, the Hualapai Indian Reservation, and the Camp Verde Indian Reservation.

However, a finding of low racial or ethnic diversity does not eliminate the need to consider potential disproportionate impacts of Forest Service management actions. A county may have a low overall concentration of minority residents, but still have areas with a high concentration of minority residents who could be adversely affected by management actions.

Gila and Navajo counties have meaningfully greater[9] shares of people living in poverty than the state overall. More than one-fifth of Gila County residents and more than one-quarter of Navajo County residents live in poverty.

Based on the minority status and poverty data presented above, Coconino, Gila, and Navajo counties appear most at risk for environmental justice issues. The largest minority group in these counties – American Indians – also experience a very high poverty rate. Between one-third and one-half of American Indians in the planning area counties live in poverty (U.S. Census Bureau 2016a).

Numerous tribes were invited to consult on the 4FRI project. The process for tribal consultation is outlined in the EIS in Chapter 1 under Public Involvement. In addition, the tribal relations section in chapter 3 of the EIS and tribal relations specialist report provide more information and complete documentation of consultation.

The conditions described in this section underscore the importance of evaluating environmental justice consequences. The economic data suggest that Navajo County is both the most underserved county (in terms of economic opportunities) and also the most reliant on forest-related employment in the study area. Therefore, Navajo County may be particularly influenced by economic changes related to 4FRI. The potential for disproportionately high and adverse impacts on minority and low-income individuals due to Forest Service management actions are evaluated in the environmental consequences section of this document.

Assumptions and Methodology

This analysis addresses the implementation of Rim Country treatments on the Apache-Sitgreaves, Coconino, and Tonto National Forests. Unless specifically indicated otherwise, all estimates of economic and social consequences are based on only the implementation of 4FRI Rim Country.

Economic Impact Methodology

Economic impacts were modeled using IMPLAN Professional Version 3.1 with 2016 data. The IMPLAN model area includes Coconino, Gila, Navajo, and Yavapai Counties. Maricopa County is also included in the economic impact model due to the economic linkages between Maricopa County and the project area. The firms and employees that would support Rim Country activities are located in these counties (both primary and supplier firms).

Data on use levels under each alternative were collected from the forests' resource specialists. In most instances, the precise change is unknown. Therefore, the changes are based on the professional expertise of the forests' resource specialists. Regional economic impacts are estimated based on the assumption of full implementation of each alternative. The actual changes in the economy would depend on individuals taking advantage of the resource-related opportunities that would be supported by each alternative. If market conditions or trends in resource use were not conducive to developing some opportunities, the economic impact would be different from what is estimated in this analysis.

9 In this case, meaningfully greater indicates that the 90% confidence interval of the county's poverty rate does not overlap with the 90% confidence interval of the state's poverty rate.

Economic Efficiency Methodology

Economic efficiency analysis follows Forest Service and Office of Management and Budget guidance. A four percent discount rate is commonly used for evaluations of long-term investments and operations in land and resource management by the Forest Service (FSM 1971.21). This discount rate is used in the calculation of net present value (NPV). Inflation can affect NPV; however, due to the uncertainty of future inflation, OMB Circular A-94 recommends avoiding assumptions about the inflation rate whenever possible. Thus, for the purposes of this analysis, inflation is left at zero. Data on program revenues and program expenditures were provided by the national forests' resource specialists and budget staff.

Assumptions

1. The IMPLAN model assumes a static economy – in other words, the industry composition and trade linkages in the economy today would be the same in the future.
2. The IMPLAN model does not impose supply constraints when estimating employment and labor income effects. It assumes that local industry would be able to harvest and process all of the forest product volume from the Rim Country project. If some of the forest product volume is harvested or processed by firms outside the model area, the employment and labor income effects would be lower than those estimated here.
3. The economic analysis assumes that all project activities are implemented over a 20-year period. If the implementation period is longer, the average annual number of jobs and amount of labor income would be lower than estimated in this report.
4. The economic analysis assumes that firms bid on 4FRI Rim Country contracts and that the activities are fully implemented. Full implementation relies on private sector interest in bidding on contracts. A slower pace and/or lower forest product volume removal would produce less economic activity than estimated in the analysis.
5. The economic analysis uses forest product distribution data from the 4FRI implementation team to classify forest product types in the economic modeling program. The economic analysis assumes the following distribution: 30 percent sawn products, 6 percent poles, 4 percent firewood, and 60 percent other forest products (including biomass).
6. The economic analysis assumes that forest products are harvested outside of protected activity centers (PACS) with mean slopes less than 40 percent.
7. The economic analysis assumes that the cost of prescribed fire treatment is $175 per acre and the cost of mechanical treatment is $400 per acre. The analysis also assumes that treatments are evenly distributed across 20 years.

Issues/Indicators/Analysis Topics

Economics is an issue for the Rim Country Project. Stakeholders are concerned that the lack of existing markets and the low value of material generated by proposed treatments may make project implementation economically infeasible. This report analyzes the economically feasibility of proposed activities across a range of alternatives.

Table 49 displays the resource indicators and measures used to evaluate the economic consequences of the Rim Country project.

Table 49. Resource indicators and measures for assessing effects

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?
Economic feasibility	Forest product volume removal	Forest Products (ccf)) harvested per year	Yes
Economic feasibility	Economic efficiency	Project benefits less project costs	Yes
Economic impact	Employment and labor income	Number of jobs and amount of labor income	Yes
Environmental justice	Effects to low-income and minority populations	Qualitative evaluation of disparate treatment and/or disparate effects	No

Environmental Consequences

Alternative 1 – No Action

Forest Products: Under Alternative 1, the three national forests would continue to provide forest products and support restoration activities. However, the scale of these activities would be substantially smaller than activities under the Rim Country Project. The provision of forest products unrelated to Rim Country treatments would be the same under all alternatives, and therefore are not described in detail in this EIS.

Economic Efficiency: Under Alternative 1, wildfire suppression costs would, on average, increase due to fuel buildup and the expanding wildland-urban interface. The per-acre administrative burden (cost of time and other resources) of planning, implementing, and monitoring forest restoration activities would be highest under Alternative 1. The Rim Country Project benefits from economies of scale – a single environmental compliance document addresses more than one million acres. Furthermore, the large project area reduces cost to government through increased private sector interest in engaging in harvesting and restoration activities on the forests. In contrast, restoration activities under Alternative 1 would occur piecemeal – requiring numerous environmental compliance documents and increased administrative costs.

Employment and Labor Income: The three national forests would continue to provide opportunities for forest product harvesting, livestock grazing, recreation, and other activities that support employment and labor income in communities in the project area. The extent of these contributions are not expected to differ from current conditions. Forestry-related sectors would remain a relatively minor part of the project area's economy.

Environmental Justice: The communities that surround the project area, particularly in Navajo County, have large minority populations, high poverty rates, and individuals vulnerable to smoke. Minority and low income residents may experience differential exposure to wildland fire, changes in employment opportunities, or changes in the provision of ecosystem services. None of the alternatives eliminates smoke – either from wildfire or prescribed burns. Alternative 1 would treat the fewest acres with prescribed fire; however, it would also do the least to restore fire-adapted forests. As a result, smoke from uncharacteristic wildfire is most likely under Alternative 1. Smoke emissions from prescribed burning would be lower under Alternative 1. Smoke emissions resulting from wildfires and prescribed burns may produce health and quality of life consequences. Smoke is most likely to affect vulnerable populations – children, the elderly, and individuals in poor health.

Alternative 1 would not affect the potential for wildland fire to threaten human safety and property in the project area. Low income individuals have fewer resources to engage in averting behavior (for example, leaving town during a wildfire to avoid smoke emissions). However, since approximately half of homes in the wildland-urban interface in the project area are second homes, the individuals with the highest exposure to wildfire risk are expected to be relatively affluent (Headwaters Economics 2017).

Alternative 1 would not affect employment or labor income in the project area. Therefore, no disproportionate or adverse effects related to changes in economic opportunities would occur as a result of this alternative.

The provision of ecosystem services may be affected by Alternative 1; however, these effects would not disproportionately affect low income and minority residents.

Table 50. Resource indicators and measures for Alternative 1

Resource Element	Resource Indicator	Measure	Alternative 1
Economic feasibility	Forest product volume removal	Forest Products (ccf) harvested	Forest products would continue to be harvested from all three national forests, consistent with current conditions
Economic feasibility	Economic efficiency	Project benefits less project costs	No direct project benefits or costs; no economies of scale in forest restoration activities
Economic impact	Employment and labor income	Number of jobs and amount of labor income	Three national forests would continue to support local employment and labor income associated with harvesting, grazing, and recreation at levels similar to current conditions
Environmental justice	Effects to low-income and minority populations	Qualitative evaluation	Smoke emissions from wildfire are most likely to adversely affect vulnerable populations, including children, the elderly, and individuals in poor health

Effects Common to All Action Alternatives

Environmental Justice: The employment and labor income associated with the Rim Country Project are expected to have a small, but positive, effect on employment and labor income in minority and low income communities.

Smoke emissions from both prescribed fire and wildfire can have health effects, particularly on the young, elderly, and individuals with existing health issues. Tribal elders may be more likely to experience acute health effects. Technological and cultural constraints to effective communication would make smoke effects more pronounced, as averting behavior is limited. However, burn plans written for implementation of the proposed prescribed fires would include modeling to determine the most appropriate conditions under which to burn in order to minimize smoke impacts.

Effects Unique to Each Action Alternative and Differences among Them

Forest Products: Alternative 2 would produce approximately 5.3 Million CCF of forest products over the life of the project. The economic analysis assumes that volume is harvested evenly over a 20-year period. Approximately 262,920 ccf would be harvested annually.

Alternative 3 would produce approximately 3.6 million ccf of forest products over the life of the project. The economic analysis assumes that volume is harvested evenly over a 20 year period. Approximately 178,530 ccf would be harvested annually.

Economic Efficiency: Under Alternatives 2 and 3, the per-acre administrative burden (cost of time and other resources) of planning, implementation, and monitoring forest restoration activities would be lower than for Alternative 1. The Rim Country project benefits from economies of scale – a single environmental compliance document addresses hundreds of thousands of acres across three forests. Alternative 2 would mechanically treat up to 889,334 acres of vegetation and treat up to 953,132 acres with prescribed fire. Alternative 3 would mechanically treat up to 483,158 acres of vegetation and treat up to 529,059 acres with prescribed fire.

The present net cost to taxpayers to conduct restoration treatments equivalent with those proposed under Alternative 2 would be approximately $370 million, and approximately $200 million under Alternative 3, over 20 years. The Rim Country Project would provide a stable supply of forest products to encourage private sector engagement in forest restoration activities, which would reduce the cost to taxpayers. Furthermore, the treatments would reduce the risk and hazard of uncharacteristic wildfire. The costs of a single large fire routinely amount to millions of dollars in direct suppression expenditures alone. The Forest Service, for instance, spent approximately $14.4 million responding to the 2010 Schultz Fire (Combrink et al. 2013). Furthermore, the total cost of the Schultz Fire and subsequent flooding – including decreased property values, loss of life, cleanup, evacuation, and habitat destruction – is estimated to be between $133 million and $147 million (Combrink et al. 2013). For the 2002 Rodeo-Chedeski Fire, estimated suppression costs ranged between $43 and 50 million. Other direct costs, including the loss of homes and property, totaled $122.5 million. Rehabilitation costs were projected over a three year period for a total cost of $139 million (WFLC 2010).

Compared to Alternative 2, Alternative 3 would treat fewer acres more intensively. More concentrated treatments could lower the operating costs associated with treatments. Fixed costs associated with site preparation would be lower, site infrastructure needs (for example, processing, roads) would be reduced, and costs associated with transporting forest products would be lower than under Alternative 2. Given the relatively low market value of most of the wood products to be removed from the project area, keeping operating costs low is critical to the financial feasibility of forest treatments.

Employment and Labor Income: The direct, indirect, and induced economic effects of forest product removal under Alternative 2 are estimated to support approximately 1,890 jobs and $78 million in labor income on an average annual basis over the life of the Rim Country Project.

Alternative 3 would produce somewhat lower wood product volume than Alternative 2. Therefore, Alternative 3 would support fewer jobs and less labor income than Alternative 2. The direct, indirect, and induced economic effects of forest product removal under Alternative 3 are estimated to support approximately 1,280 jobs and $53 million in labor income on an average annual basis over the life of the Rim Country Project.

Both Alternatives 2 and 3 may temporarily displace other forest users (for example, recreation visitors) due to treatment activities. Alternative 2 would lead to more displacement of forest visitors than

Alternative 3 due to the larger number of acres to be treated under Alternative 2. Displaced recreationists are expected to visit another site on one of the three forests to participate in another activity in the local area. Therefore, recreation visitor expenditures are not expected to change.

Likewise, forest restoration activities may affect ranchers who graze livestock in the project area. The brief duration and advance notice of disturbances due to Rim Country treatments would make it easier for ranchers to adapt to changes. As a result, no reductions in grazing-related employment are expected. However, minor reductions in rancher income are possible if ranchers purchase more expensive private forage or reduce their stocking levels. However, post-treatment soil and forage quality is expected to increase. Therefore, over the long-term, ranchers would benefit from Rim Country activities.

Table 51. Resource indicators and measures alternative comparison

Resource Element	Resource Indicator	Measure	Alternative 2	Alternative 3
Economic feasibility	Forest product volume removal	Forest products (ccf) harvested	Volume from trees < 5" = 278,440 CCF Volume from trees 5" - 12"= 2,303,480 CCF Volume from trees > 12"= 2,676,470 CCF	Volume from trees < 5" = 191,000 CCF Volume from trees 5" - 12"= 1,467,810 CCF Volume from trees > 12" = 1,911,750 CCF
Economic feasibility	Economic efficiency	Project benefits less project costs	$370 million present net cost; Avoided costs from forest restoration and reduced risk of high intensity wildfire	$200 million present net cost; Avoided costs from forest restoration and reduced risk of high intensity wildfire; more concentrated treatments (compared to alternative 2) would lower operating costs
Economic impact	Employment and labor income	Number of jobs and amount of labor income	1,890 jobs and $78 million in labor income	1,280 jobs and $53 million in labor income
Environmental justice	Effects to low-income and minority populations	Qualitative evaluation	Employment and labor income may have a small, but positive, effect on economic opportunities in low-income and minority communities; smoke emissions may have a disproportionate effect on low-income and minority communities	Same as alternative 2

Effects from Rock Pit Use and Expansion

The Rim Country Project would authorize the use and expansion of rock pits to supply material for road construction and improvement. Rock pits on the national forests provide a low cost source of material for road work. In particular, rock pits avoid the need to purchase and haul roadbed material from more distant sites. The 2016 Rock Pits Environmental Assessment for the Coconino and Kaibab National Forests found that haul costs were approximately four times higher for material purchased off-site than for on-forest rock pits. Rock pit use and expansion would increase the financial feasibility of road work needed to support Rim Country project activities.

Effects from Use of In-woods Processing and Storage Sites

The key barrier to the financial feasibility of forest restoration is that the costs of hauling raw material from the harvest site to mill locations may exceed the value of the timber harvested in the project area. To address this challenge, the Rim Country Project would authorize 13 in-woods sites (in addition to the eight sites analyzed in the Cragin Watershed Protection Project) for processing, sorting, storing, and the refinement of raw material. In-woods processing and storage sites would offset haul costs by increasing the value of material either by hauling dried material or secondary products.

In-woods processing and storage site selection criteria – including at least ¼ mile from hiking trails, campgrounds, group recreation sites, and private property – would reduce the potential for effects on forest visitors and nearby residents.

Cumulative Effects for all Alternatives

Past management activities, including mechanical vegetation treatments, fuels treatments, and prescribed fire, have affected economic activity in the communities in and around the project area. The socioeconomic consequences of these actions are captured in the baseline data presented in the affected environment section of this report. Therefore, these activities are not included in the cumulative effects analysis.

The temporal boundary is 20 years of implementation activities and the spatial boundary is the economic analysis project area (Coconino, Gila, Navajo, and Yavapai Counties).

Restoration activities would continue to occur in the region regardless of the Rim Country decision. Current and foreseeable activities include approximately 470,000 acres of mechanical vegetation treatments and approximately 650,000 acres of fuels treatments. The acreages of mechanical vegetation management and fuels are not all mutually exclusive. There are many acres on which proposed fuels treatments (mechanical and prescribed fire) overlap with proposed mechanical vegetation management treatments. Reasonably foreseeable actions on private, state, and other federally-managed lands include mechanical treatments, fuels treatments, and prescribed fire. These actions would occur regardless of the selected Rim Country alternative.

The effect of past, present, and reasonably foreseeable treatment activities in the project area would improve forest health relative to existing conditions even without the implementation of the Rim Country Project.

Forest Products: Forest products available for harvesting under the Rim Country Project would contribute to an increased supply of forest products available from national forests in the region. When harvest volumes are low, harvesting and processing industries are unlikely to locate in the region. However, the cumulative effects from both Alternative 2 and Alternative 3 would be to improve the financial viability of locating forest product industries - including logging firms, sawmills, and biomass facilities – in the project area. The no action alternative would have the least cumulative effects to forest products industries since no forest products would be harvested.

Economic Efficiency: Present net costs are greatest under alternative 2, so the cumulative effects (costs) of the Rim Country project, in addition to other projects, would be the greatest. The no action alternative does not have any costs of treatment for Rim Country, so cumulative costs would be the least.

Observational evidence and fire modeling indicates that large-scale fuel treatments are necessary to meaningfully reduce the risk of high intensity wildfire and produce fire suppression cost savings (Thompson et al. 2017). The proposed Rim Country treatments, in combination with the current and foreseeable mechanical and prescribed fire treatments, would conduct fuel treatments across a large landscape. The cumulative effects of Alternative 2 are most likely to reduce wildfire suppression costs in the project area.

Employment and Labor Income: The increase in jobs and labor income during implementation of the Rim Country project would be greater under alternative 2 than alternative 3 and the no action alternative, which would be additive to job contributions from other current and foreseeable projects in the area. Therefore, the cumulative economic impacts would be greatest under alternative 2.

The increased forest product supply from Rim Country and other current and foreseeable projects would contribute to the development of a local forest products industry. Cumulatively, the development of a local industry, as a result of Rim Country and other projects, would have several economic effects, including (1) lower costs of transporting wood products for secondary processing thereby increasing the financial viability of treatments, (2) increase the probability that employment and labor income associated with forest restoration activities would occur in the local area, and (3) contribute to the growth of supporting industries (for example, construction and retail trade).

As described in the Affected Environment section above, there has been limited growth of jobs and income from 4FRI phase one implementation activities. With more acres treated from the Rim Country 4FRI project, this would add to the wood utilization employment. Cumulative effects of increasing wood volume could increase the amount of economic contributions that stay in the region if the activity boosts the infrastructure and capacity to process the harvested wood in the region. For example, if the wood produced from both phases of 4FRI implementation creates enough demand (or the funding mechanism is collaboratively resolved) for a company to install a biomass facility, the jobs and income from restoration activities are more likely to stay in the region.

Environmental Justice: Ongoing and reasonably foreseeable prescribed fire treatments would contribute to smoke emissions, which may affect the health and quality of life of individuals who live near or visit the forests. Since the no action alternative would not prescribe additional treatments, it would not cause cumulative effects related to smoke emissions from prescribed fire. However, the risk of uncharacteristic wildfire and associated smoke emissions in the project area would be highest under this alternative.

The proposed treatments under Alternatives 2 and 3, combined with other ongoing and foreseeable treatments, could increase exposure to smoke emissions, which could cause cumulative effects to health and quality of life for individuals who are sensitive to smoke. However, the cumulative effect of these treatments would be to decrease the risk of uncharacteristic wildfire, which would decrease the probability of smoke emissions associated with these events. The no action alternative would have lower additive effects to smoke exposure but in the longer term would contribute to a greater risk of wildfire.

Forest Plan Amendment

Amending the forest plan is not expected to have any additional effects to social or economic resources, other than what is already analyzed. The harvest volumes and treatment acres (and associated costs) are not expected to differ than what is proposed and analyzed under alternative 2 and alternative 3. Costs of treatment may be higher on steeper slopes (due to Amendment 3. Mechanical treatments on steep slopes), however, this is uncertain and the best cost estimates are used in the analysis.

Lands and Minerals

Affected Environment

Lands

The acquisition and disposal of National Forest System lands are designed to consolidate interest and management of the federal estate to enhance public benefit, and to consolidate the management and ownership of federal, state, and private lands within the proclaimed forest boundary. The establishment of rights-of-way throughout the forest is needed to create easy accessibility to both public and private lands within the proclaimed boundary of the national forest.

Land subdivision and development is increasing the need for accurate and reliable surveys. Numerous conflicts between past surveys have occurred, leading to an unknown number of unauthorized occupancies and use violations on national forest lands. Identification of property boundaries is an increasing expense to resource programs, especially fuel treatments. Increasingly, additional expenditures would be necessary in order to fully utilize national forest resources and to prevent claims against the federal government. Although land acquisition eliminates the need for land line location in some areas, many miles of property boundary still need to be surveyed and posted.

Property boundary location involves all activities necessary to identify the boundaries of National Forest System lands, including the search for survey corners, surveying and marking of land lines, and maintenance of the same. Marking and posting boundaries identifies or locates National Forest System lands for public use and enjoyment and prevents and controls trespass upon the forests.

There are many private land inholdings within the Rim Country project area. To ensure any treatment is done on private land and to meet Forest Service policy, the boundary lines between Forest Service and private lands should be marked by a professionally-licensed land surveyor prior to implementation. This would also ensure the lines are adequately marked so the Forest Service can meet objectives stated in the Apache-Sitgreaves Forest Plan for Community-Forest Intermix and Wildland-Urban Interface, as well as similar direction in the other forests (Coconino and Tonto National Forests) within the Rim Country project area. Boundaries are considered marked to standard if they have been surveyed and posts set at approximately 250-foot intervals along the boundary line and have been set with boundary signs attached. Some historic boundary lines can be maintained, which entails ensuring posts and signs are in good condition and replacing any that are not. This can be accomplished with surveys that have been recently completed. Any posting older than 15 years may be questionable because of age. The current status of boundary lines in the project area is shown in Table 52 below.

Table 52. Miles of boundary lines within the project area

Forest	Total Miles	Marked	Unmarked	Marked over 15 years ago
Apache-Sitgreaves	374	231	143	182
Coconino	110	55	55	42
Tonto	132.5	125	7.5	75

Overall, it is important to provide ample time to existing land surveying staff to analyze implementation areas and access needs, and provide feedback on necessary time and funding to complete work.

In addition to marking and posting boundary lines before resource work is completed, there are also numerous pieces of direction in the forest plans on how land within the Wildland Urban Interface and Community-Forest Intermix should be treated. This direction calls for lower basal areas, treatment of slash, and retention of fire-resistant tree species. There is very little restriction on what kind of treatments are used, but forest plans do convey the message of minimized smoke effects, reduction of fuel load, and working with communities on defensible space.

The existing access routes through the project area may travel across both forest system and private lands. It is important for the ensure rights-of-way are properly obtained in order to protect existing or new roads crossing private property by describing type and duration of use. If a permanent easement for standard use can be obtained in an area that was not historically documented, this would be beneficial to both parties to guarantee the road's protection in the future.

Lands Special Uses

Lands special use authorizations include permits, term permits, leases, and easements that authorize occupancy and use of National Forest System lands. Authorized activities include uses such as utility corridors, roadways, communications sites, research projects, and many other uses. The terms of these authorizations vary based upon the type of use.

Table 53. Lands Special Use Authorizations within the Project Area

Permit Type	Total
Fish Hatchery	2
Fence	2
Cemetery/Church/Monument	3
Waste Disposal Site (solid/liquid)	2
Sewage Line	3
Weather Station	9
Observatory	1
Research/Non-Disturbing Use	8
Warehouse/Storage Yard	4
Processing Plant	1
Powerline	10
Easement	85
Road	21
Communication Site	42
Irrigation/Water Transmission/Conveyance	35
Dam/Reservoir/Well/Storage Tank	20
Wildlife Water Supply	10
Stream Gauge	2
Water Treatment Plant	1
TOTAL	**261**

As of August 29, 2017, there were 261 active lands special use permits within the project area. Of these, 219 (85 percent) are communication sites, water storage or conveyance, powerlines, roads/easements, or water or waste treatment facilities. These uses have direct effects on human populations and therefore carry greater risks from fire danger than other uses.

Recent years show an increasing demand for lands special uses. As communities in and around the forests increase in development, their need to utilize public lands in support of their infrastructure also increases. Proposals for power lines, rights-of-way, communication sites, water transmission lines, and roadways have increased steadily and would continue to do so in future years. Increased interest in renewable energy sources, such as wind and solar, has also contributed to the increased demand.

Solar energy potential is high and future development would be related to demand. There may be a need for additional energy corridors or developments (for example, electric transmission lines, pipelines, wind turbines) because of the expected demand for electricity to serve the growing populations of Arizona and the Southwest and to provide reliable and consistent services. As communities expand and as non-Forest Service lands surrounded by Forest Service lands are developed, there may be increased demand for energy development on Forest Service lands.

Minerals

Minerals of economic interest are classified as leasable, locatable, or salable. Coal, oil shale, oil and gas, phosphate, potash, sodium, geothermal resources, and all other minerals that may be acquired under the Mineral Leasing Act of 1920, as amended, are referred to as leasable minerals. Common varieties of sand, stone, gravel, pumice, and clay that may be acquired under the Materials Act of 1947 are considered salable minerals. Any minerals that are not salable or leasable, such as gold, silver, copper, tungsten, and uranium, are referred to as locatable minerals. These mineral deposits include most metallic mineral deposits and certain nonmetallic and industrial minerals. Locatable minerals are subject to the Mining Act of 1872.

Apache-Sitgreaves

Mineral resource activity on the Apache-Sitgreaves National Forests has historically been low. Mineral activity is presently concentrated in a few scattered areas. Commodity use and production have shown declines from the past. However, these forest uses contribute to sustaining the lifestyles and traditions of local communities. The potential for locatable minerals on Apache-Sitgreaves National Forests lands may be much greater at depth than surface geology would otherwise suggest. The potential for leasable minerals on the Apache-Sitgreaves National Forests is low because of the existing geology. There are no known leases on the forests for the following leasable mineral resources: oil and gas, oil shale, coal or geothermal (BLM 2009/2013). Should valid leasable mineral proposals be submitted, the Forest Service would respond as a cooperating agency when requested by the BLM, which acts as the lead agency for subsurface mineral extraction. There are no current leases for oil and gas, geothermal, or coal on the Apache-Sitgreaves National Forests.

Coconino

The Coconino National Forest has very few locatable mineral resources, and no oil and gas leases or developments, but has potential geothermal resources (no current leases, no developments) associated with the San Francisco Volcanic Field. Locatable minerals with past or current production have included manganese, gypsum, flagstone and pumice. The forest has a small amount of common variety mineral materials production including cinders, crushed and pit run aggregate, rock and fill dirt, and landscape rock/decorative stone. Most of the use of mineral materials on the forest is by the Forest Service or authorized contractors or permittees for projects and by Coconino County under permits or other agreements. Aggregate production and salable minerals are anticipated to increase with future forest restoration activities. Some areas are withdrawn from locatable mineral entry.

Tonto

No leasable mineral authorizations or applications are currently located on the Tonto National Forest. The potential for development of leasable minerals in the planning area is low; the geologic depositional environment of the planning area is not conducive to hydrocarbon generation. The Tonto National Forest has a long history of mining across the national forest.

Although numerous prospects on the Payson Ranger District were identified from the Arizona Department of Mines and Mineral Resources database, most of the gold and silver deposits were found within veins found fairly close to the surface with visible mineralization. Most of the metals could be extracted with minimal milling effort, usually with a stamp mill. Most if not all of the mineralization occurred within "quartz stringers" of a granodiorite intrusion (Botsford 1933). Once these narrow dikes (bands) are mined out, only the "non-visible" or disseminated mineralization is left behind, which requires a much greater milling process and larger scale operation to be profitable.

Arizona is well known for its large porphyry copper deposits, which are low-grade disseminated type deposits that require mining by large-scale, low-per-ton cost methods. The copper minerals are distributed uniformly through large sections or blocks of the deposit, that must be mined by bulk methods, rather than selective or vein mining methods. These bulk mining methods consist of either open-pit or block caving mining methods. Gold and silver occur as secondary metals that are associated with porphyry-type deposits. Based on historic activity of this district, further exploration efforts may have merit. As a result, the favorability for mineral potential within the Green Valley Mining District and two other districts, the Polk and the Rye Creek, is determined to be moderate (USDI 1993). Although no exploration activity is currently taking place on the Payson Ranger District, the potential for such activities remains.

Assumptions and Methodology

Assumptions

The following assumptions were made for this analysis:

- Forest Plan direction would be followed when planning or implementing site-specific projects and activities resulting from this decision.
- Applicable laws, regulations, and policies would be followed when planning or implementing site-specific projects and activities resulting from this decision.
- With population growth in the communities within and surrounding the forest, as well as throughout the State of Arizona, there would be increased demand for uses such as alternative energy development, utility corridors, and transportation systems.
- Community and public needs for use of federal land for services and infrastructure, including roads and energy corridors, would continue.
- Proposals for lands special uses, mineral exploration, and energy development on the national forests would increase in the foreseeable future.

The primary assumption for the analysis of effects on lands, lands special uses, and minerals is that the number of acres treated under each alternative corresponds directly to a reduced risk of uncharacteristic wildfire behavior within the project area. This in turn corresponds to a reduced risk of damage to structures and facilities within the project area. Therefore, the greater the number of acres treated, the greater the reduction in uncharacteristic fire behavior, and therefore the greater positive effect to these resources. This correlation holds true regardless of the mix of treatment methods used (such as, mechanical thinning, prescribed burning).

Methodology

The Special Uses Database System (SUDS) was used to generate a list of all special use authorizations within the project area. This report was sorted by use type; recreation special uses were then removed from the analysis. The remaining lands special use authorizations were then sorted by status. They were considered as part of the existing condition if they had statuses of application accepted, pending signature, or issued.

Some inaccuracies are commonly known to exist in the SUDS. Permits are sometimes shown as "issued" even after they have expired, or sometimes are shown as expired when in fact they have been reissued and the activity continues. Where it was known or suspected that these permits were still in place and in the process of reissuance, they were considered in the analysis.

Mineral resources were identified using the specialist reports and supporting materials for the Forest Land and Resource Management Plan Revisions for each forest in the project area.

Issues/Indicators/Analysis Topics

None of the significant issues for Rim Country relate to the potential effects on lands, lands special uses, or minerals, and therefore they do not serve as indicators for analyzing the effects of the project on these resources. However, the project would have an indirect effect in the form of reduced risk of uncharacteristic fire behavior. Uncharacteristic fire behavior presents a threat to the facilities authorized by special use permits and to any structures that may lie on non-forest lands within the project area. Therefore, the indicator used for this analysis is the reduced risk of uncharacteristic fire behavior, as represented by the number of acres treated under each alternative.

Environmental Consequences

Alternative 1 – No Action

Under this alternative, no large-scale restoration activities would occur. Stand and vegetation structures would be improved only in accordance with each forest plan, and with the data available at the time of this report, this would be occur on only 140,324 acres. This would make the landscape in the project area less resilient to disturbance and would provide increased fuels for wildland fires and uncharacteristic fire behavior. Increased fire danger would impact lands special uses by threatening the structures they authorize in both the short term (10 years) and long term (20 years and more). Any structures associated with active minerals sites and those located on non-National Forest Service lands would be similarly threatened. Long-term effects could be the destruction of these facilities by fire, and possibly the closure of fire-damaged areas for rehabilitation. There may be short-term, temporary effects in the form of restricted access to sites during fire suppression activities or post-fire rehabilitation.

Many of these authorized land uses serve and support local communities. If infrastructure is damaged by wildfire, there could be a delay in providing utilities such as power, phone, and water. Emergency service providers could be delayed in providing for health and safety if communication equipment is damaged. Private property has the potential to be impacted as a result of wildfires in the area as fires may burn at a higher intensity and severity and would be more difficult to control. Existing land uses would continue to be managed under the current forest plan direction and under the terms of their authorizations and other laws, policies, and regulations such as power line clearance requirements and vegetation management along highway corridors for safety purposes and utility reliability.

Effects Common to All Action Alternatives

All action alternatives would improve forest health by restoring forest ecosystems toward their natural, pre-fire-suppression states. While they vary in specific approaches, the overall effect on lands, lands special uses, and minerals would be the same. Increased forest health would lower the risk of undesirable fire behavior, which would reduce the threat to the structures authorized for lands special uses and mineral projects and to those on private lands.

Effects Unique to Each Action Alternative and Differences among Them

For the purposes of this analysis, the only difference between action alternatives is the number of acres treated.

Table 54. Comparison of Alternatives by Number of Total Acres Treated

Alternative	Acres Treated Under This Project	Total Acres Treated in Project Boundary
1	0	140,324
2	889,340	1,039,654
3	483,160	615,254

Effects from Rock Pit Use and Expansion

The Rim Country Project would require the use of mineral materials for the surfacing of temporary roads and possible resurfacing/maintenance of roads after their use in the implementation of this project. The scope of work proposed in the action alternatives exceeds the mineral materials currently available in existing rock pits within or near the project area. Therefore, the use of one additional rock pit and the expansion of some existing rock pits are being analyzed in the Rim Country EIS.

On the Coconino National Forest, the development, expansion, and use of nine rock pits in the Rim Country project area were analyzed in the Rock Pits Environmental Assessment for the Coconino and Kaibab National Forests (June 2016). One additional rock pit, Park Knoll, is currently being developed by Coconino County under a special use permit; the Forest Service would have access to approximately 20,000 cubic yards of material from this pit.

On the Apache-Sitgreaves National Forest, two ranger districts are within the project area, the Lakeside and Black Mesa Ranger Districts. Surfacing material needs on the Lakeside Ranger District are met by a large county-operated rock pit under special use permit, as well as other commercial sources. On the Black Mesa Ranger District, 11 existing rock pits in the Rim Country project area could be expanded to provide future material for implementation of Rim Country. Each of these rock pits are considered for 30 percent expansion of their current footprint. The potential environmental effects from the anticipated expansion of these rock pits, as well as those from their use, are analyzed in the Rim Country EIS.

On the Tonto National Forest, all road surface material needs would be met by local commercial sources. Therefore, no effects from rock pit use on the Tonto are analyzed for Rim Country implementation. Figure 81 displays the locations of these rock pits in the Rim Country project area.

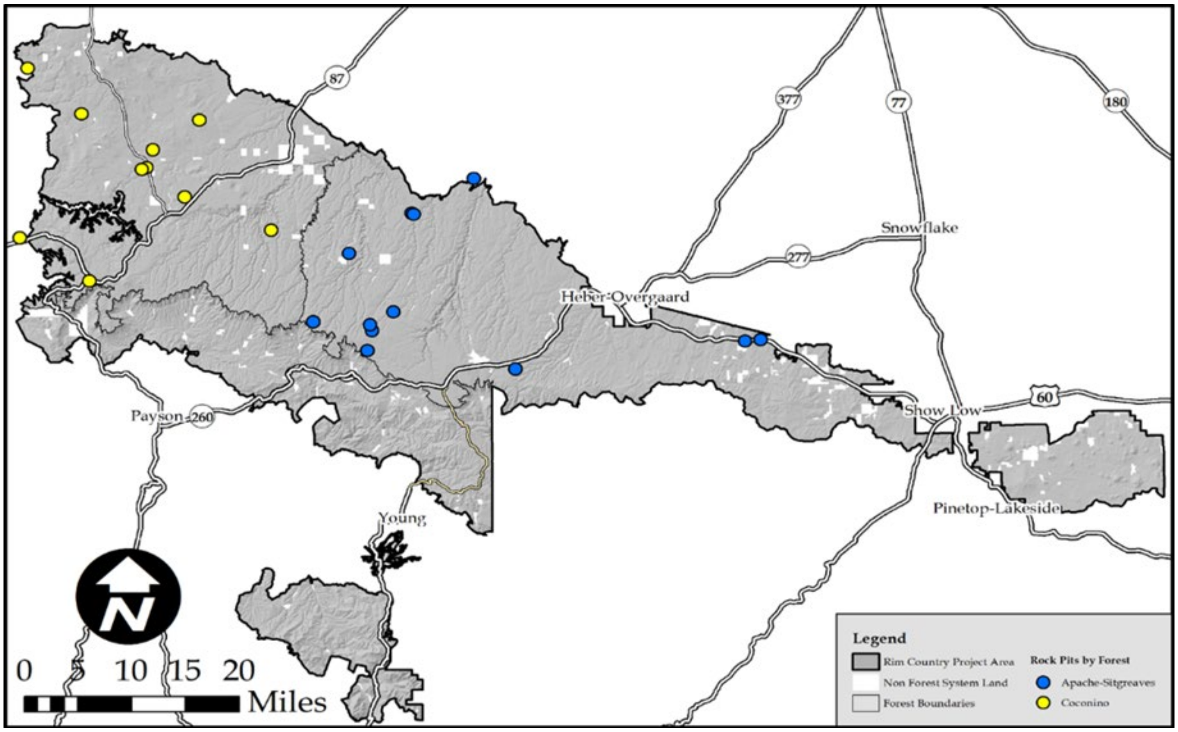

Figure 81. Rock pits in the Rim Country project area

Rock pit use and expansion would be the same under both action alternatives. There would be no effects on lands or lands special uses. The effect on minerals would be that, once used, these resources would no longer available for other future projects. The consumption of mineral resources for road surfacing needs for the Rim Country Project must be weighed against the cost of purchasing these materials from a commercial source in the future. As budgets continue to shrink, this would be an important consideration. The Coconino and Tonto National Forests receive very high levels of use, and road surfacing would continue to be an ongoing need.

Effects from Use of In-woods Processing and Storage Sites

The western parts of the project area are far from businesses that are able to process the wood products that would result from either of the action alternatives. To make the business opportunities more viable, the project identifies multiple on-forest sites that could potentially be used by contractors for processing wood products.

The closest mill to Rim Country is the Lumberjack Mill, approximately 13 miles from Heber, Arizona, just north of the eastern edge of the project area. The Lumberjack Mill is operated by Good Earth Power. The mill underwent an extensive upgrade in 2017 and is currently processing dry kilned and finished lumber. On the western side of Rim Country, the closest wood processing facility is Canyon Wood Supply, approximately 25 miles from the western boundary of the project area in Camp Verde, Arizona. Canyon Wood Supply processes ponderosa pine into bundled fuelwood for retail consumption.

Processing sites serve many purposes. Tasks accomplished at processing sites would include drying, debarking, chipping stems and bark, cutting logs, manufacturing and sorting logs to size, scaling and weighing logs, and creating poles from suitable sized logs. Equipment commonly used at processing sites would include circular or band saws, various sizes and types of front-end loaders, log loaders, and several types of chippers. Equipment may include timber processors, planers and mechanized cut to length systems, associated conveyers, and log sorting bunks for accumulation and storage of logs. Electric motors and gas or diesel generators would also be used to provide power.

Eight processing sites were proposed and analyzed for environmental effects in the Cragin Watershed Protection Project (CWPP). These sites are carried forward for potential use in implementing the Rim Country Project. In addition, 13 in-woods processing sites are being proposed and the environmental effects from their use analyzed in the Rim Country EIS. For both projects, processing site location and siting considerations include: flat uplands less than five percent slope; more than 200 feet from perennial, intermittent, and ephemeral stream channels; more than 300 feet from meadows, springs, and karst features; more than ¼ mile from MSO PACs and outside of NOGO PFAs; more than ¼ mile from system hiking trails, campgrounds, and group event recreation sites; more than ¼ mile from private lands, residences, or offices; and adjacent to roads that are open year-round for product removal. Processing sites were located to provide a buffer of 100 to 300 feet from forest roads and state highways to provide for visual screening from Concern Level 1 and 2 travelways.

These 20 in-woods processing and storage sites may be used for implementation of the Rim Country Project over its implementation period of 20 years, or until implementation is completed. Continuous-use processing sites are those where use is expected to be continuous on a regular basis for 10-20 years. These sites are typically the larger 10 to 21 acre areas located close to major highways. Sites originally developed and operated for continuous use would frequently change to intermittent use or occasional use following initial harvest activities in the area. Intermittent use processing sites are those where use is expected to be shorter term and used for one or multiple contract periods, lasting from three to 10 years.

Processing sites may be authorized under timber contract or under special use authorizations. Special use authorizations for processing sites would comply with appropriate policies related to cost recovery and land use fees and other special use regulations (36 CFR 251). A performance bond would be used to insure that all obligations are fulfilled by the contractor or permittee and would be used if needed to cleanup and rehabilitate the processing sites.

Processing site locations and use are the same under both action alternatives. There would be no effects on minerals. There would only be effects on lands or lands special uses if the sites were located too closely to these resources. It is possible that sites in close proximity to special uses such as utility corridors or water lines could have an adverse effect these facilities, if they interfere with operations. Such effects could be mitigated by ensuring placement of processing sites away from special use facilities

Residents living within the project area boundaries could be impacted by the increased noise, traffic, and emissions produced by active operations at processing sites. These effects would be greater the closer processing sites are to any private lands or special use facilities with residents. These effects can be mitigated by advance communications with any residents and notifying them of potential active operation timeframes.

Cumulative Effects

The cumulative effects analysis area for lands, lands special uses, and minerals is the Rim Country project area.

Alternative 1 – No Action

Vegetation treatments would reduce the risk of uncharacteristic fire behavior on approximately 140,000 acres within the project area. Restoration activities would occur on a project-by-project basis, rather than as a part of a landscape-scale effort. The threat of uncharacteristic fire behavior to lands, lands special uses, and mineral site structures would be reduced somewhat within the project area, but not as much as under the Action Alternatives.

Alternative 2

Under this alternative, approximately 953,130 acres would receive vegetation treatments and restoration activities. This is a 60 percent increase over the no action alternative. Alternative 2 would treat the greatest number of acres and therefore contribute the most toward the reduction of fire risk to lands, lands special uses, and mineral site structures. Fire damage to the facilities or structures in these areas would mean destruction of private property and damage to utility corridors for electricity and water. This would have a significant impact to communities relying on these utilities.

Alternative 3

Under Alternative 3, approximately 529,060 acres would receive vegetation treatments and restoration activities. This represents 44 percent fewer acres than Alternative 2, but a 44 percent increase over alternative 1. The threat of fire to lands, lands special uses, and mineral site structures would be greater than under Alternative 1 but less than under Alternative 2. Therefore, the risk of damage to or destruction of utility corridors and private property are also greater than Alternative 1 and less than Alternative 2. This alternative provides the greatest reduction in fire risk to these resources and therefore the greatest positive effects to the people owning these structures and the communities relying on these utilities.

Tribal Relations

Affected Environment

All of the lands in the 4FRI Rim Country project area are the ancestral homelands of American Indian tribes. The archaeological resources in the project area demonstrate a high level of traditional uses which continue today (see the Cultural Resources section for more details concerning archaeological resources). In lands occupied by their ancestors, tribal members continue traditions of hunting, collecting medicinal plants, and conducting traditional ceremonies. This includes American Indian traditional use areas and places known as Traditional Cultural Properties (TCPs). TCPs are places traditionally used by cultural groups over generations. These TCPs hold a central and important place in American Indian culture. Through years of tribal consultation the forests have learned that many natural springs, prominent bodies of water, mountains, subsistence areas, prayer areas, shrines, clan origin locations, holy places, trails and shelters (Sweat lodges and brush shelters) are considered TCPs by numerous tribes.

Tribal members make pilgrimages to the Rim Country forests for ceremonial activities throughout the year. Springs in the project area and throughout the forest are valued as TCPs and sacred sites. Many plants gathered for ceremonial use are collected on or near TCPs.

Tribal Consultation

The Forest Service and Tribes have legislative authority to partner under law, including but not limited to the Indian Financing Act of 1974, the Cooperative Funds and Deposits Act of 1975, the Forest and Rangeland Renewable Resources Research Act of 1978, the Federal Technology Transfer Act of 1986, the Department of Interior, Environment and Related Agencies Appropriations Act of 1992, the Tribal Forest Protection Act of 2004 (TFPA), the Culture and Heritage Cooperative Authority of 2008 (CHCA), and the Wyden Amendment (Public Law 109-54, Section 434). These authorities provide opportunities to exchange technical expertise, funding, goods, and services to the mutual benefit of both parties. An effective government-to-government relationship would provide for the identification of common goals and partnership opportunities. For additional guidance, see FSM 1563 (2015 draft).

Assumptions and Methodology

Assumptions made are as follows: no activities would adversely affect archaeological sites or traditional cultural properties; the removal of excess fuels is a benefit to cultural resources, traditional cultural properties, traditional use forest products, and adjacent tribal lands; low heat prescription wildfires can result in the regeneration of medicinal plants; mechanical thinning of specific species can protect other plant species of cultural importance (such as Emory oak groves); restoration activities would benefit natural springs which are of universal importance to Indian tribes; Indian tribes would be consulted at critical points before project activities.

Issues/Indicators/Analysis Topics

Traditional Collecting Areas - Dense tree growth and heavy ground fuels can have a negative effect on certain plant species; thinning the forest may provide a better habitat for these plants to thrive. Fire can also enhance certain plant species such as wild tobacco. Restoration activities could positively affect the sustainability and availability of traditionally important plant species and natural springs.

Smoke Impacts - Increases in prescribed fire in all alternatives (no action, Alternative 2, and Alternative 3) create the potential for increased smoke impacts. Most of the smoke from prescribed fires on the Coconino and Tonto National Forests would carry from the southwest to the northeast, potentially affecting the Havasupai Reservation and western portions of the Navajo Nation Reservation. Many people living in these areas are seniors with health conditions and are sensitive to smoke. The effects of limited communications (they cannot get on a website to check out where we're burning, etc.), language barriers, and cultural differences make it difficult to get information to them and receive information in return about smoke impacts. There is a general lack of smoke monitoring data on the reservations. Therefore, those living on these reservations may be disproportionately affected by smoke from burning by the various agencies (especially from multiple fires on multiple jurisdictions). Coconino County has a significantly higher poverty rate than the other counties and the states of Arizona and Utah. The incidence of poverty in Coconino County is not evenly distributed among racial and ethnic groups. Approximately 50 percent of American Indian residents in Coconino County live in poverty. The high proportion of American Indian residents in the county therefore increases the poverty rate relative to other study area counties and the state (Eichman and Jaworski 2011).

Environmental Consequences

Alternative 1 – No Action

Direct effects as a result of the no action alternative would result in the loss of native plant species, an increase in springs drying up, and a greater threat of devastating wild fires. Also, with continued drying trends across the southwest, the forests would issue forest closures and fire restrictions thus effecting traditional uses and ceremonies.

TCPs are at risk to catastrophic fire because it can destroy the setting of the TCP. Springs and plant collection areas are at risk to catastrophic fire because of excessive runoff from monsoon rain washing in ash and debris in a fire-devastated landscape. Overstocked stands are reducing the sunlight available for cultural and medicinal plants and catastrophic fire could destroy seed and habitat for native plants. A lack of low-intensity fire is reducing regeneration of plants collected by native people.

Soil erosion due to uncharacteristic wildfires could have both direct and indirect effects on traditional collecting areas. Rain and snow melt could cause channels to form, or mud slides from nearby slopes could deposit soil and debris over traditional areas, leading to the loss of biological communities for both plant and animal species used by the tribes.

The no action alternative may result in the possible reduction over time of pre-settlement adapted native plants, some of which have been collected since historical times by American Indians for food and medicine. Additionally, springs and seeps are important locations to American Indians and other members of the public; increasingly overstocked forests might affect those historic water sources.

Effects Common to Both Action Alternatives

The ground-disturbing activities associated with these two alternatives (2 and 3) are not significant enough to analyze separately.

Alternatives 2 and 3 would increase the amount of ground-disturbing activities, including mechanical treatments, prescribed burning, temporary road construction, skidding, stream restoration, and fence construction. When considered together with the past, present, and reasonably foreseeable future actions, these activities have the potential to affect cultural resources such as traditional collecting, gathering, ceremonial use areas, and TCPs. All undertakings that have the potential to affect cultural resources would go through tribal consultation. In addition, protection measures such as the possibility of tribal monitors during mechanical activities, keeping ground-disturbing activities out of sensitive areas by flagging and avoiding the sensitive areas, and post-prescribed burn monitoring to assess the effects of the low-intensity burns, would help to minimize the effects. The potential cumulative effects on cultural resources and TCPs such as springs from increased ground-disturbing activities and prescribed burning in these alternatives are therefore not considered to be adverse.

Cumulative Effects to Both Action alternatives

The cumulative effects on TCPs, and gathering and ceremonial areas resulting from any potential increase in erosion would also be minimal. Reducing fuel loads and implementing low to moderate-intensity prescribed fires do not cause soil sterilization or hydrophobic soils as high intensity wildfires do. Low-intensity prescribed fires leave some vegetation in place and re-vegetation occurs soon afterwards if soils are not sterilized. However, as implementation occurs, monitors would check for erosion concerns by examining culturally sensitive locations like TCPs and ceremonial sites in the implementation areas, including focusing on slopes, drainages, and other areas with a high probability of cultural resources. The cumulative effects on cultural resources caused by an increase in erosion are not considered to be adverse. An increase in these types of activities would not result in an adverse effect on cultural resources as long as tribal consultation is conducted prior to project implementation, protection measures are imposed, and post-project implementation monitoring is conducted when appropriate.

Range

A summary of the range specialist report is presented here and the complete report is incorporated by reference (Hughes 2018). Refer to the Range Report for additional information on methodology, the grazing history of the project area, and supporting information. This analysis incorporates questions designed to evaluate movement toward desired conditions and concerns brought up by the public during scoping: (1) How would project activities affect livestock grazing management in the project area? (2) How would project activities affect livestock forage in the project area? (3) Would livestock grazing affect the restoration of understory species?

Affected Environment

The affected environment for the range analysis is the Rim Country project area, approximately 1,240,000 acres. Only allotments within the project area are considered. Within the project area, approximately 1,129,490 acres are within grazing allotments and 109,170 acres are not grazed by livestock. The majority of the understory vegetation within the grazing area is dominated by Arizona fescue, mountain muhly, pine dropseed, blue grama, and squirreltail grasses.

Within the project area there are 70 livestock grazing allotments, with 69 active allotments and one vacant. Of these 70 allotments, 68 permit cattle grazing and two permit sheep grazing (one being a sheep driveway). The amount of each allotment lying within the project area varies from less than 1 percent to 100 percent.

Assumptions and Methodology

Annual planning occurs prior to the livestock grazing season. During this planning the livestock numbers and the grazing season are developed based on several factors including the previous year's management plans and outcomes, current year's predictions, and current resource conditions. During the grazing season, changes may be needed to the rotation or numbers, due to unexpected changes in conditions, such as those caused by drought or fire. This is a piece of the adaptive management cycle. Annual monitoring typically includes an assessment of current conditions, a measure of livestock usage and actual use. Long-term monitoring usually consists of condition and trend monitoring every five to fifteen years measuring plant canopy cover, plant frequency, species composition, and/or ground cover.

Design features, best management practices, mitigation and conservation measures have been developed to be used during implementation to protect range resources as well as other resources from grazing effects.

Environmental Consequences

Alternative 1

Direct and Indirect Effects

In Alternative 1, there would be no management activities occurring within the project area as a result of the Rim Country Project. Because no activities would occur, tree densities and canopy cover would remain high and understory plant cover would stay the same. Over time, tree densities and canopy cover would continue to increase, under which understory vegetative cover and production would decline. Understory species would also be reduced because of the buildup of pine needles and the lack of nutrient cycling.

The reduction in understory vegetation over time would reduce the amount of forage available to livestock. Over time, livestock numbers may need to be reduced. This reduction in forage and decrease in livestock numbers has been recorded throughout the project area. There is no reason to believe that this trend would not continue under Alternative 1.

Under Alternative 1, additional prescribed fire would not occur in the project area. Without these acres of prescribed burning, no pasture rest periods would be necessary after burning.

Since no treatments are planned in Alternative 1, grazing management would continue as has generally been planned and actually carried out in the past. However, this alternative would not adequately reduce the increased risk of uncharacteristic wildfire.

Uncharacteristic wildfires can burn with high severity and burn through multiple pastures, burning fences and other structural range improvements. Uncharacteristic wildfire would have an adverse effect on livestock grazing management and forage until the area recovers and structural improvements are replaced.

Effects Common to Both Action Alternatives

The environmental consequences for Alternatives 2 and 3 are based upon the application of design features and other resource protection measures, and are based upon the environmental consequences in the silviculture, fire and air quality, and wildlife sections.

Tree thinning and prescribed burning would increase understory vegetation. Understory species and composition would change primarily by increasing shade-intolerant understory species and decreasing shade-tolerant species. Understory species would also be increased because of the reduction of pine needles and the increase in nutrient cycling provided by burning. All these factors would improve forage production for livestock within the areas treated.

Both Alternatives 2 and 3 would directly decrease tree density by mechanical tree thinning and prescribed burning. An increase in the groupy/clumpy arrangement would substantially increase herbaceous species production by creating openings between these groups. The indirect effect of cutting trees in a groupy/clumpy arrangement would increase herbaceous vegetation because of the overall increase in sunlight reaching the soil. The increase in forage would have short-term (within three years) and long-term 10-year beneficial effects on livestock grazing.

In research near the project area, herbaceous production dropped from greater than 650 pounds per acre to 100 pounds per acre when basal area increased above 50 square feet/acre (Pearson and Jameson 1967). In another study, grasses increased by more than 470 percent cover in high-intensity harvest units compared to a 53 percent increase in pre-treatment control units (Stoddard et al. 2011). Griffis et al. (2001) also found that the abundance of native grasses increased significantly along with treatment intensity throughout thinned and burned stands.

The increase in forage within treatment areas would improve allotment conditions and allow for more flexibility in grazing management systems. Livestock distribution would improve because forage is more available in uplands. An increase in pasture graze periods would allow for additional pasture rest or deferment in other pastures within an individual allotment.

Prescribed burning would have an adverse effect on livestock grazing by removing forage available to livestock. This effect would be short term until the forage plants regrow, typically within one year. This effect would be offset by the long-term increase in forage after burning. The prescribed burning would be phased throughout the project area to minimize effects on individual allotments. Most allotments in the project area have the ability to rest a pasture for one year after a burn with little effect on overall allotment grazing management. However, livestock numbers or season of use might have to be adjusted in some allotments because of the combined effects from prescribed burns and other factors like wildfire and drought. If the burned areas do not recover within a year, then livestock would likely continue to run in the same pastures, reducing the amount of rotational grazing on an allotment. Adaptive management would continue to be used to adjust livestock management to meet annual forage production, with or without the burns.

Adjustments in grazing of livestock after prescribed fires are a mitigation to reduce effects on forage species. These mitigations have shown to maintain static understory conditions in grazed areas. Adjustments needed, such as rest or deferment are difficult to determine because each pasture’s response to ground-disturbing treatments (including mechanical thinning and prescribed fire) is unique. Climatic conditions, soils, vegetation, the severity of fire effects, burn amount, intensity of vegetation treatments, and pasture management may vary greatly from year to year or from pasture to pasture.

The removal of trees during mechanical thinning operations would have little effect on livestock grazing. Mitigations would be implemented to maintain structural range improvements and keep livestock within designated pastures during these operations. Pastures may be deferred during operations to minimize equipment and livestock conflicts, but it is not mandatory. Mechanical thinning has been conducted throughout the project area for many years with few effects on livestock grazing operations, although post-treatment inspections may result in changes to annual pasture rotations (such as deferment).

Mechanical and fire treatments (Intermediate Thin, Stand Improvement, and Uneven-aged) would leave tree groups with differing sizes of interspaces between the tree groups. Treatments in the 40 to 55 percent and the 55 to 70 percent interspace ranges would result in an increase in herbaceous cover and production, and the treatments in 10 to 25 percent, 10 to 40 percent, and 25 to 40 percent interspace ranges would still result in an increase in herbaceous cover and production, but less of an increase than the higher interspace treatments.

Single-tree selection treatments leave fewer tree groups and more randomly spaced trees. They are designed to increase or maintain age class diversity and reduce understory brush and shrub response, creating small openings less than or equal to 1/4 acre in size. This type of treatment would result in an increase in herbaceous cover and production in the openings created. Aspen restoration treatments, mechanical and prescribed fire facilitative operations, and savanna, grassland, and meadow restoration treatments would result in an increase in herbaceous cover and production. Severe disturbance area treatments, have an objective of restoring forest cover, which if it involves tree planting, would reduce herbaceous cover and production slowly over time.

Spring exclosure areas would not be available for livestock grazing and would have an adverse effect on available forage within a pasture. However, these exclosures would not be large enough and would not amass in any particular pasture to reduce pasture stocking rates. In addition, by the time these exclosures would be completed, it is anticipated the increase in pasture forage by the tree thinning and burning would help to offset the forage lost within the exclosures. Spring projects would not have a measureable impact on the capacity of allotment or grazing management.

Stream and riparian area restoration would have a long-term benefit to livestock grazing management by increasing forage, by improving bank stability, and by decreasing the amount of sediment to downstream stock tanks. Excluding livestock from these restoration areas would be short term.

Aspen exclosure areas would not be available for livestock grazing and would have an adverse impact on available forage within a pasture. However, the majority of these exclosures would not be large enough or amassed in any particular pasture to reduce pasture stocking rates. Aspen projects would not have a measureable impact on the capacity of an allotment or grazing management.

Road decommissioning would have a beneficial effect on livestock grazing by growing additional forage in the old road bed. Constructing temporary roads would have a temporary adverse effect to livestock grazing when the forage on the road was disturbed. No road project would have a measureable impact on the capacity of allotments or grazing management.

Effects from Use of In-woods Processing and Storage Sites

The development and use of the proposed processing areas would make any potential forage unavailable to livestock grazing for approximately 20 years from their initial development. These processing sites would reduce the amount of forage available in these areas which could last up to 20 years. This effect would be small compared to the size of the allotment, and would likely have no noticeable effect on livestock management.

Alternative 2

This alternative has the largest amount of acres proposed for treatments, leading to the biggest increase in forage production. This alternative also proposes the most acres of severe disturbance area treatments, which could include treatment options such as tree planting. These areas are generally within previously burned areas, such as the Rodeo-Chediski fire area. If the tree planting treatment is chosen, a decrease in production would occur overtime, in these areas.

This alternative contains the largest amount of acres proposed for mechanical treatment and prescribed fire. Therefor this alternative would have the most livestock management adjustments, such as pasture rest or deferment, following treatments.

Alternative 3

This alternative would also have an increase in forage production resulting from the proposed treatments. Due to less proposed acres of treatment, the overall forage production would be less than with alternative two. This alternative also proposes less acres of severe disturbance area treatments than is proposed in alternative two, which could include treatment options including tree planting. These areas are generally within previously burned areas, such as the Rodeo-Chediski fire area. If the tree planting treatment is chosen, a decrease in production would occur overtime, in these areas.

This alternative contains has acres proposed for mechanical treatment and prescribed fire. Therefor this alternative would have the fewer adjustments needed, such as pasture rest or deferment, following treatments than with alternative two.

Cumulative Effects

The area considered for cumulative effects analysis includes 100 percent of the acres within allotments that occur within the project area. This is a logical boundary because changes to grazing management in one pasture of an allotment affect the management in the entire allotment.

The time frame for these combined effects is 23 years, 20 years for project implementation and three years following implementation for the forage to respond to treatments. Changes in condition of the vegetation depend on the presence or absence of favorable growing conditions. If growing conditions are favorable, plant height and canopy cover would completely recover from the effects of the proposed forest management activities within one to two years. If growing conditions are not favorable, plant recovery may occur more slowly (up to two or more years). Vegetation recovery from the other activities and natural events may take this long depending on annual weather conditions particularly annual precipitation.

Continuation of current management, absent the proposed treatments in the Rim Country project area, would result in further reductions in forage production over time with the increase in tree density. Past restoration projects within and close to the project area have increased forage and understory vegetation. Forest Service policy and forest plan direction is to manage for uneven-aged stands and allow fire to return to its nature role in ecosystems. Current grazing management uses adaptive management to meet objectives established in existing allotment management plans. Past vegetation and prescribed fire projects have resulted in the current resource conditions.

The cumulative effects on livestock grazing management and livestock forage from Alternative 1 would be no change in the short term, but would result in a long-term decrease in forage with the increase in tree density. The 4FRI Rim Country project area would not be treated with the additional activities proposed. When other current and foreseeable projects are considered, 282,291 acres would be treated (168,416 acres of mechanical thinning and 113,875 acres of burning), which would increase forage production. Livestock grazing management decisions such as if pastures would be rested or deferred would be determined through inspections. With fewer treatment acres, there would be fewer adjustments on pasture rotations.

The treatments proposed in Alternatives 2 and 3 would overlap with the other current and reasonably foreseeable projects in the project area. Any overlap, when added to forage production improvements from other projects, the understory species in Rim Country would result in a positive cumulative increase in production, more in alternative 2 than in alternative 3. Livestock grazing management decisions such as pasture rest or deferred rotations would increase with the acres of treatments in both action alternatives, more in alternative 2 than alternative 3, and would be determined through inspections.

Transportation

A summary of the transportation report is presented here. The specialist report (Rich 2018) is incorporated by reference.

Affected Environment

Forest system roads within the analysis area are managed in accordance with current management objectives that are based on a variety of needs for access and use of forest resources. The system of roads ranges from primitive, unsurfaced roads (maintained for resource protection and not user comfort), aggregate surfaced roads (maintained for varying degrees of user comfort), and double-lane asphalt-surfaced state highways. These roads form a transportation system that provides access to the area for a variety of uses, including vegetation treatments, fuel treatments, fire suppression, and recreation. The majority of these system roads were planned and constructed during past commercial timber harvest activities and are not accessible year-round by all types of vehicles. These roads were designed for primary use by a standard log truck. In addition to passenger vehicles and high clearance vehicles, many of these roads are used by off-highway vehicles, hikers, mountain bikers, and horseback riders.

Some roads within the project area are poorly located. They may be overly steep and difficult to drain, located in drainages, too close to streams, or a number of other situations. Many of these roads are difficult to maintain and are causing soil and water resource damage.

The number of miles of county, state, and federal highways within the project area and that provide access to the project area and link it with potential wood processing facilities is not estimated. Since the location of potential future processing facilities is unknown it is not possible to designate all public roads which may or may not be used for accessing the area.

Current National Forest System Roads within Rim Country

Currently there are approximately 5,682 miles of Forest Service roads within the project area on Forest Service lands. Table 55 displays the miles of road by operational maintenance level.

Table 55. Summary of existing road mileage

Maintenance Level	A-S	Coconino	Tonto	Total
1- Basic Custodial Care (closed)	1,747	189	140	2,076
2 - High Clearance	856	1,417	591	2,864
3 - Suitable for Passenger Vehicles	347	240	82	669
4 - Moderate Degree of User Comfort	22	11	38	71
5 - High Degree of User Comfort	0	0	2	2
Total System Roads	**2,972**	**1,857**	**853**	**5,682**

Assumptions and Methodology

The Rim Country project area consists of 1.24 million acres on the Apache-Sitgreaves, Coconino, and Tonto National Forests. Within this area, several other environmental analyses have been conducted in recent years. These previous analyses affect the type of transportation analysis conducted in this document.

Two environmental assessments, totaling 61,101 acres, were recently analyzed for transportation needs for mechanical thinning and also for road decommissioning. No additional transportation analysis was conducted in these areas within the Rim Country EIS project area. These projects are:

- Larson- 29,921 acres- Apache-Sitgreaves National Forests
- Upper Rocky Arroyo- 31,180 acres- Apache-Sitgreaves National Forests

Six other environmental assessments totaling 192,187 acres, analyzed only for transportation needs for timber harvesting and did not analyze for any road decommissioning. These projects are:

- Upper Beaver Creek- 48,245 acres- Coconino National Forest
- Clints Well- 16,825acres- Coconino National Forest
- CC Cragin- 63,867 acres- Coconino National Forest
- Rim Lakes- 33,746 acres- Apache-Sitgreaves National Forests
- Show Low South- 4,624 acres- Apache-Sitgreaves National Forests
- Timber Mesa-Vernon- 24,880 acres- Apache-Sitgreaves National Forests

On the Coconino National Forest, 212,720 acres are identified for mechanical treatment as part of the Rim Country EIS. On the Apache-Sitgreaves National Forests, 243,995 acres are identified for mechanical treatments. On these two forests, all mechanical treatments are assumed to require adequate road access to facilitate the removal of forest product resulting from forest restoration work.

On the Tonto National Forest, 210,251 acres have been identified for mechanical treatment as part of Rim Country; however, many of these acres are dominated by chaparral, juniper, or other vegetation with less ponderosa pine present. While these areas may be mechanically treated, it is unlikely that mechanical thinning would be carried out on all of these acres due to the small amount of merchantable material present.

Areas not proposed for mechanical treatments with wood products removal would not need the same level of access as those areas where forest products would be utilized. A minimum of 100 square feet of basal area per acre of ponderosa pine was used to determine which acres would likely need adequate road access to remove forest products. Based on this analysis, 80,561 acres on the Tonto were analyzed for temporary road construction needs. The remaining 129,690 acres on the Tonto were not analyzed for temporary road construction needs, as removal of forest products is considered to be unlikely.

As a result of the previous analyses in the 4FRI footprint, and the basal area threshold of 100 square feet per acre on the Tonto National Forest, temporary road needs are only analyzed for 243,995 acres of the Apache-Sitgreaves National Forests, 212,720 acres of the Coconino National Forest, and 80,561 acres of the Tonto National Forest, for a total of 537,276 acres within the Rim Country project area.

Road decommissioning is analyzed for 1,080,341 acres within the Rim Country EIS project area. This represents the entire project area outside of the Larson and Upper Rocky Arroyo analysis areas, which have already been analyzed for road decommissioning.

Issues/Indicators/Analysis Topics

The following significant issue was identified for the Rim Country Project:

> The miles of temporary roads in the proposed action may negatively affect watershed and stream conditions, and wildlife habitat and connectivity. Commenters asked that the Forest Service limit road networks to those roads needed for access and management. Commenters requested an alternative that dramatically reduces temporary road mileage.

Indicators/Measures:

Indicators would include the range of temporary roads that may be needed in each of the alternatives, measured by the approximate number of miles of temporary roads proposed in each alternative.

Environmental Consequences

Alternative 1 – No Action

Use of Existing Roads

Under Alternative 1, no new restoration activities would take place and no additional use of existing roads would occur. Current rates of public and administrative use would continue.

Road Maintenance

Under Alternative 1, maintenance to provide public and administrative access would continue, contingent upon funding. No increase in road maintenance to accommodate restoration activities would occur.

Road Decommissioning

Under Alternative 1, no road decommissioning would occur within the project area unless it is analyzed under separate NEPA analysis.

Temporary Roads

Under Alternative 1, no new temporary roads would be constructed, unless constructed under separate NEPA analysis

Rock Pit Use and Expansion

Under Alternative 1, there would be no expansion of existing pits. Current use of existing and new pits analyzed under separate NEPA would continue.

Use of In-woods Processing and Storage Sites

Under Alternative 1, no in-woods processing and storage sites would be created or used; therefore there would be no effects resulting from them.

Effects Common to Both Action Alternatives

An adequate transportation system to provide access for restoration work and for removal of forest products generated from restoration activities is critical for accessing stands identified for mechanical treatment. Listed in the following paragraphs are practices that are common to all action alternatives.

Use of Existing System Roads

It is assumed that nearly all of the existing roads within the Rim Country analysis area may be used to provide access for a variety of restoration activities, including hauling of forest products resulting from mechanical treatments. Nearly all of the forest system roads within the project area are ML 1, 2, or 3 roads. This analysis addresses temporarily opening existing closed roads (ML 1) to utilize them for the time period they are needed to provide access for restoration work. These roads would be closed upon completion of work in the area they access and returned to a closed status (ML 1).

The preferred alternative in the Tonto Travel Management EIS proposes that 354 miles of ML 2 roads be converted to motorized trails. These roads have received minimal maintenance over the years and their current condition is not anticipated to improve (narrowing, roughening up, or otherwise modifying the road as it's redefined to a motorized trail). Full size vehicles would be authorized to use these routes under Tonto Travel Management and they would be managed as motorized trails. It's anticipated that pre-haul maintenance is all that would be needed in the future to prepare the motorized trails for use to access mechanical treatment areas.

Roads used for hauling of forest products under this analysis would be maintained or improved in order to meet road management standards under National Best Management Practices for Water Quality Management on National Forest System lands.

Road Maintenance

Road maintenance is defined as, "The upkeep of the entire transportation facility including surface and shoulders, parking and side areas, structures, and such traffic-control devices as are necessary for its safe and efficient utilization. This work includes brushing of roadside vegetation, falling danger trees, road blading, cleaning ditches, cleaning culvert inlets and outlets, etc." (36 CFR 212.1)

Road maintenance on roads that receive substantial use by the public are maintained by the Forest Service on a regular basis as funding allows. When there is a substantial increase in use of a road by a Forest Service contractor for uses such as hauling, this contractor is usually required to perform maintenance both during and after their use of the road commensurate with their use. This maintenance is often blading and reshaping of the road surface. Road maintenance on roads that are closed to the public would be performed by the logging contractor.

Roads used for hauling of forest products under Rim Country would generally be maintained by contactors. This maintenance would likely be done while the road is being used and at the completion of hauling. All maintenance performed by contractors would be in accordance with Forest Service maintenance standards.

Road Decommissioning

Road decommissioning is defined as: "Activities that result in the stabilization and restoration of unneeded roads to a more natural state." (36 CFR 212.1, FSM 7705 – Transportation System) The Forest Service Manual (7712.11- Exhibit 01) identifies five levels of treatments for road decommissioning which can achieve the intent of the definition. These include:

- Block entrance
- Revegetation and water barring
- Remove fills and culverts
- Establish drainage ways and remove unstable road shoulders
- Full decommissioning, recontouring and restoring natural slopes

These five treatments provide a wide range of options to stabilize and restore unneeded roads. In some cases restoration may be achieved by blocking the entrance. In other situations, the more extensive activities listed above may be called for.

This analysis does not identify specific road segments for decommissioning. Rather it would provide the NEPA decision to decommission roads and road segments at the time that task orders or other projects are implemented. Roads would be evaluated for decommissioning at that time.

Roads may be decommissioned for a variety of reasons, including but not limited to roads that are:

- No longer needed for future management
- To protect cultural resources
- Causing soil or water resource damage
- Not useable without significant investment beyond current and future funding levels
- An ongoing road maintenance challenge
- An unauthorized road (an unauthorized roads is defined as road that is not a forest road or a temporary road and that is not included in a forest transportation atlas).
- Other unique situations

Under this alternative both National Forest Systems roads and unauthorized roads could be decommissioned. When a system road is decommissioned it is also removed from the National Forest Road System. Transportation Analysis Process (TAP) reports for the Coconino, Apache-Sitgreaves, and Tonto National Forests and site-specific on-the-ground evaluations would be considered in selecting roads for decommissioning.

On the Tonto National Forest, decommissioning of system roads is being analyzed as part of the Tonto Travel Management EIS and roads for decommissioning are identified. Roads identified for decommissioning under the Tonto Travel Management EIS could be physically decommissioned as part of restoration work undertaken to implement the Rim Country EIS.

Unauthorized roads within the project area on all forests could be decommissioned under this decision. Roads currently designated as open on a forest's Motor Vehicle Use Map would not be decommissioned or closed under the action alternatives. Unless already identified for decommissioning under the Tonto Travel Management, roads on all three Rim Country forests that are needed to provide reasonable skidding distances for future harvesting would not be decommissioned. Also, roads that are needed to provide access to leases and other special uses on National Forest System lands would not be decommissioned unless other suitable access is provided. If these roads are needed for future management, but are a problem for soil and water resources, they would instead be relocated.

Road Relocation

Road relocation is defined as moving an existing road from its current location and re-locating it to a new location. Unfortunately many roads within the project area are poorly located and were never properly designed. As a result these roads are in need of relocation. Roads that could be considered for relocation include those that are:

- Too steep, resulting in significant erosion
- Below the level of the surrounding land and are difficult to drain.
- Are too close to a seasonal or perennial waterbody and contributing sediment to the waterbody
- Other unique situations
- Any combination of the reasons listed above

When roads are relocated, their former location would be decommissioned. This would result in little if any net gain or loss in road mileage in most cases. Road relocation of a system road is not considered construction of a new permanent road. It is considered a relocation of an existing road.

This analysis does not identify specific road segments for relocation. Rather it provides the basis to relocate roads and road segments at the time that task orders or other projects are implemented. Roads would be evaluated for relocation at that time.

Temporary Roads

The Collaborative Forest Landscape Restoration Act (CFLRA), does not allow for the construction of new permanent roads in CFLR projects. Any new road constructed under CFLRA must be a temporary road and cannot be added to the national forest road system. All new road construction in this project is considered temporary.

A temporary road is defined as: "A road or trail necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road, or trail and that is not included in the transportation atlas." (36 CFR 212.1)

In order to provide adequate access to the project area for timber removal, temporary roads would need to be constructed in some locations, and are intended to provide short-term access to a specific area for wood products removal and/or follow up treatments, such as prescribed burning. Temporary roads are often used to provide economically feasible skidding distances in harvest operations. Following completion of work in the area they serve, temporary roads would be decommissioned and made impassable to vehicles. Decommissioning would be accomplished with one or more of the five levels of treatments described above.

Temporary roads might be either new construction or utilize existing road prisms of unauthorized roads. Temporary road mileage for each action alternation is listed under that alternative.

Rock Pit Use and Expansion

Rock pit use and expansion could require a limited amount of temporary road. This mileage is included in the estimated temporary road mileage under each action alternative.

Use of In-woods Processing and Storage Sites

In-woods processing and storage sites could require a limited amount of temporary road. This mileage is included in the estimated temporary road mileage under each action alternative.

Effects Unique to Each Action Alternative

Alternative 2 – Modified Proposed Action

Temporary Roads

Under this alternative up to 330 miles of temporary road could be created and utilized to facilitate mechanical treatments. These temporary roads might be new construction or utilize existing unauthorized roads. Temporary roads would be decommissioned when thinning and related restoration work is completed in the areas they access.

Alternative 3 – Focused Restoration

Temporary Roads

Under this alternative up to 170 miles of temporary road could be created and utilized to facilitate mechanical treatments. These temporary roads might be new construction or utilize existing road prisms of non-systems roads already present. Temporary roads would be decommissioned when thinning and related restoration work is completed in the areas they access.

Cumulative Effects

The spatial boundary for this cumulative effects analysis is the Rim Country Project Area. The time frame for the analysis begins in 2010, and was selected because it captures all the decisions that include the applicable transportation system activities in the cumulative effects spatial boundary. . The timeframe extends to twenty years into the future because that is what is reasonably foreseeable for implementation of the Rim Country Project.

Construction of temporary roads would expand the existing transportation system within the project area to provide adequate access to all stands in need of mechanical treatment. Construction of temporary roads would allow nearly all stands to be harvested with a maximum skidding distances of 1,250 feet or less. Temporary roads may also be used for access for prescribe fire and other restoration activities. Following completion of activities in an area temporary roads would be decommissioned.

Alternative 1 – No Action

Under Alternative 1, there are no proposed activities so there would be no cumulative effects in the project area from; use of existing roads, road maintenance, road decommissioning, temporary roads, rock pit use and expansion, and use of in-woods processing and storage sites.

Cumulative Effects Common to Both Action Alternatives

Use of Existing Roads
Under both action alternatives use of existing roads would be in addition to current use by the public, contractors, and permittees on national forest system lands.

Road Maintenance
Under both action alternatives road maintenance performed would be in addition to road maintenance performed currently under a forest regular program of road maintenance

Road Decommissioning
Under both action alternatives up to 200 miles of system road on the Coconino and Apache-Sitgreaves National Forests could be decommissioned. The Tonto National Forest Travel Management EIS has identified approximately 290 miles of road within the Rim Country project area for decommissioning. In addition to system road decommissioning, up to 800 miles of unauthorized roads on all three forests could be decommissioned under these alternatives. In addition to these road mileages the Larson and Upper Rocky Arroyo environmental assessments on the Apache-Sitgreaves National Forests identified 18 miles of system road 57 miles of unauthorized road for decommissioning.

Road Relocation
Under both action alternatives any roads relocated under this alternative would be in addition to roads relocated on other projects within the Rim Country project area.

Overall, the cumulative effect to the transportation system in the project area from the action alternatives would result in a more sustainable road system that would provide access for the Rim Country Project Area.

Alternative 2-Modified Proposed Action

Temporary Roads
There are approximately 50 miles of temporary road that have been analyzed under separate project within the project area and are in various stages of implementation. When these are added to the 330 miles proposed in alternative 2 the total mileage of temporary roads is 380 miles within Rim Country analysis area, which is more than under alternative 3. Cumulatively these temporary roads would serve as access to their respective treatment areas for the duration of the projects they are constructed for. The

Alternative 3- Focused Alternative

Temporary Roads
There are approximately 50 miles of temporary road that have been analyzed under separate projects within the project area and are in various stages of implementation. When these are added to the 170 miles under proposed in alternative 3 the total mileage of temporary roads is 220 miles within the Rim Country analysis area, which is less than under alternative 2. Cumulatively these temporary roads would serve as access to their respective treatment areas for the duration of the projects they are constructed for.

Terrestrial Wildlife

This section includes key effects and conclusions for terrestrial and plant threatened, endangered, and proposed species and critical habitat listed under the Endangered Species Act of 1973, as amended, Forest Service Southwestern Region Sensitive Species, forest management indicator species, and migratory birds. The Terrestrial Wildlife Report (Schofer et al. 2018) and Botany and Weeds Report (Crisp 2018) are incorporated by reference. Aquatic species were analyzed separately in the Aquatics Report (Coleman 2018).

See the specialist reports (project record) for detailed information on methodology, analysis assumptions, best available science and data, habitats, populations, and effects that are not repeated in this section.

Affected Environment

Vegetation Cover Types Within the Project Area

The cover types in the Rim Country project area possess key habitat features outside of the natural range of variation (NRV). These forests have less structural diversity due to more acres occurring as even-aged forest compared to historical conditions. Structure is also limited by the abundance of young and mid-aged trees and the decrease in mature and old-growth trees. These conditions do not meet forest plan direction for the ratio of age-classes interspersed across the landscape.

Habitat structure within the project area can determine the presence or absence of wildlife species. Many wildlife species select habitat provided by large and old trees, including bark gleaners (for example, pygmy nuthatches and hairy woodpeckers which are both MIS), cavity nesters (for example, MSO which is a threatened species), communal roosting species (for example, Allen’s lappet-browed bats, a sensitive species), and larger/heavier nesting species (for example, northern goshawks, a MIS and sensitive species). Simplifying structure and declines of habitat features like aspen, Gambel oak, and the herbaceous community reduce habitat for an array for wildlife species from multiple trophic levels, including invertebrate communities and larger carnivores.

Springs, Riparian Areas, and Stream Channels

Many riparian streams in the Rim Country project area, particularly within the Rodeo-Chediski Fire area, are currently non-functioning or functioning-at-risk, with accelerated erosion and increased peak flows.

There are approximately 360 miles of fish-bearing streams in the Rim Country project area. These streams provide habitat for 12 native fish and two gartersnakes, including seven federally-listed species and four Regional Forester sensitive species (see the Aquatics specialist report).

Desired conditions for riparian streams are that they are capable of filtering sediment, capturing and/or transporting bedload (aiding floodplain development, improving flood-water retention, improving or maintaining water quality), and providing ground water recharge within their natural potential. Their necessary physical and biological components provide habitat for a diverse community of plant and wildlife species including cover, forage, available water, microclimate, and nesting/breeding/transport habitat. Stream habitats and aquatic species depend upon perennial streams or reaches and their habitat is maintained by the watershed, soil, and riparian conditions within the ecosystem.

Desired conditions for streams and aquatic habitats are to support native fish and other aquatic species, providing the quantity and quality of aquatic habitat within the natural range of variation. This includes increasing habitat complexity such as pools and large woody debris, reducing downcutting and sedimentation, improving riparian areas that provide channel stability and leaf litter, and providing stream shading to maintain water temperatures.

Assumptions and Methodology

Best Available Science

This analysis is based on best available scientific information. Data sources include research and life history literature and technical reports (see Literature Cited section), forest plan standards and guidelines, participation of researchers and managers from other agencies (as cited in this report), approved survey protocols, professional judgment, and the integration of other specialist reports for this project (Silviculture, Fire and Air Quality, Soils and Watershed, and Transportation) to determine effects on wildlife species and their habitats (see project record for additional information). The Rim Country interdisciplinary team developed spatially-defined databases for use in a Geographic Information System (GIS) from which the majority of the data and information contained in this report were derived. This database includes variables related to forest structure and forest health (such as, wildlife habitat such as snags, downed logs, tree density, size classes, and species, old growth, wildlife habitat classifications, and understory biomass index (see project record for additional information)). See the Silviculture and Fire Ecology and Air Quality Reports for details on the metrics used in this report and their respective modeling approaches, definitions, and assumptions.

Climate Change

The Climate Change Vulnerability Assessment for the Coconino National Forest and Rim Country project area (USDAFS 2017) identifies that 60 percent of the Rim Country project area is at moderate vulnerability, and 13 percent is at high vulnerability. At the ERU level, 50 percent of the mixed conifer was rated as very high vulnerability or risk of type conversion. Eighty-eight percent of the ponderosa pine ERUs were rated as high vulnerability.

The change in understory structure and palatability affects a wide array of wildlife from elk to arthropods, including a suite of prey species for goshawks and MSO. Climate change is predicted to lead to changes in fire patterns, increased evaporation and drought stress, reduced snowpack, and alters hydrologic timing and quantity (Marlon et al. 2009, NFWPCAP 2012).

Certain habitats are more vulnerable to a changing climate. For example, springs 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, many springs in the Rim Country project area are sensitive to variable precipitation and likely to dry up during prolonged drought. Along with increases in summer temperatures, climate change effects may make it harder for some riparian and wetland species to survive and challenge efforts to reintroduce some species into their historic range (Committee on Environment and Natural Resources 2008).

Recent work locally that focused on the 4FRI landscape supported these findings. Implementation of the proposed Rim Country activities would be in alignment with these recommendation.

Spatial and Temporal Scales

Effects on species and their habitats were evaluated at multiple scales. Depending on the species and specific analysis, this could include the site (based on stand data), watershed, ERU, and/or individual forest. Data used was generated from modeling identified in the Silviculture Report. The timeframe for short-term effects is after treatment (2029), representing conditions after all tree cutting and tree removal occurs, followed by prescribed fire in 2029 and 2039. The timeframe for short-term effects associated with aspen treatment is 2019 (when tree cutting is complete) and 2029 (when one prescribed fire has been conducted). The timeframe for long-term effects is 30 years after treatment, or 2049.

Whenever possible, species-specific habitat and locality data were used. Additionally, data queried by potential natural vegetation type (PNVT) and forest plan management area (Tonto NF) or desired conditions (Coconino and Apache-Sitgreaves National Forests) were used to help with analysis of effects on species' habitats.

Data is typically rounded to the nearest 10 acres, mile, or percentage. Most values have been rounded from their actual decimal values. Totals were calculated before any values were rounded in order to give the most accurate sum. Any apparent inconsistency between the total values reported in a table and a sum resulting from adding up individual values in a table typically accounts for a discrepancy of about 1 percent in the case of rounding percentages or miles, and fewer than 2 acres in the case of rounding acres. Similarly, rounding may have been applied to text discussions and calculated variables reported in tables.

Roads for Hauling Forest Materials in Wildlife Habitat

The Transportation Report assumes that nearly all of the existing roads in the Rim Country project area may at some point in time be used to provide access for a variety of restoration activities, including hauling of forest products resulting from mechanical treatments.

It is proposed in the Tonto Travel Management DEIS that 354 miles of ML2 roads be converted to motorized trails. These have received minimal maintenance over the years and their current condition is not anticipated to improve (narrowing, roughening up, or otherwise modifying the road as it's redefined to a motorized trail). Full size vehicles would be authorized to use these routes under Tonto Travel Management and they would be managed as motorized trails. A motorized trail is defined as "a route 50 inches or less in width or a route over 50 inches wide that is identified and managed as a trail." It is anticipated that pre-haul maintenance is all that would be needed in the future to prepare the motorized trails for use to access areas to be treated.

The Flexible Toolbox Approach for Mechanical Treatments

Appendix 2 of the Wildlife Specialist Report contains the complete Flexible Toolbox Approach for Mechanical Treatments. The proposed approach builds on the methods used in the 1st 4FRI EIS, but expands upon it to give the desired flexibility in mechanical treatments in areas with or without other management constraints (such as Mexican spotted owl (MSO) and goshawk (NOGO) habitat, or sensitive soils).

Analysis Methods to Evaluate Environmental Consequences from Alternatives on Mexican Spotted Owl Habitat

Key features of MSO habitat described in the Recovery Plan include Primary Constituent Elements of habitat important to the MSO such as:

- A range of tree sizes and ages with a preponderance of trees greater than 12 inches in diameter,
- basal area and density of pine and Gambel oak,
- Canopy cover and structure,
- Tree sizes suggestive of uneven-aged management, and
- Large dead trees (snags) with a diameter of 12 inches or greater.

MSO populations are influenced by prey availability. Key features of prey habitat include:

- High volume of fallen trees (mid-point diameter of 12 inches or greater) and other woody debris
- Plant species richness, including woody species
- Residual plant cover to maintain fruits, seeds, and regeneration to provide needs of MSO prey species, and
- Other improvements to prey habitat
- Primary Constituent Elements Related to Canyon Habitat (one or more of the following):
- Presence of water (often providing cooler air temperature and often higher humidity than surrounding areas.
- Clumps or stringers of mixed conifer, pine-oak, pinyon-juniper, and/or riparian vegetation:
- Canyon walls containing crevices, ledges, or caves: and.
- High percentage of ground litter and woody debris.

These forest structure elements are reflected in the evaluation criteria and are used to describe the existing condition of the habitat and the effects of the proposed activities according to FVS modeling over a thirty-year period from the existing condition in 2019, to 2029 and 2049.

- Acres treated and improved by habitat/vegetation type by alternative within MSO habitat type (protected and recovery habitats).
- Changes in basal area by tree size-classes to show effects from uneven-aged management by alternative within MSO habitats.
- Changes in Quadratic Mean Diameter in inches, trees per acre, Stand Density Index, Canopy Cover, and Basal Area Average by alternative in MSO habitats.

To analyze the effects of alternatives on snags, downed logs, and coarse woody debris the following habitat variables were modeled and reviewed:

- Change in number of snags per acre with a diameter of 12 inches and greater by alternative in MSO habitats (average number of snags 12 to 18 inches, 18 to 24 inches, and greater than 24 inches in diameter).
- Change in tons per acre of coarse woody debris surface fuel three inches or greater.

To analyze the effects of alternatives on understory to provide MSO prey habitat measures in MSO Habitats the following variables were modeled and reviewed:

- Snags per acre greater than 12 inches (average of snags 12 to 18 inches, 18 to 24 inches, and greater than 24 inches) and coarse woody debris in MSO habitats.
- Changes in tons per acre of shrub and herbaceous biomass (to maintain fruits, seeds, and regeneration to provide needs of MSO prey species) in MSO habitats.

To analyze the effects of fire by alternative in MSO habitats the following variables were modeled and reviewed:

- Changes in tons per acre by alternative of total surface fuel.
- Changes in potential fire behavior (fire hazard index) by alternative in MSO habitats.
- Changes in risk of crown fire by alternative and MSO habitats.

Uncertainty and Risk

The practice of prescribed fire has evolved over time and it is commonly used as a tool to reduce surface fuels while also maintaining forest structure/wildlife habitat components such as snags, logs, and coarse woody debris. However, prescribed fire is not a precise tool and there is inherent uncertainty and so potential risk with fire management. There is also risk and uncertainty in not addressing uncharacteristic surface fuel loads in fire-adapted ecosystems.

Monitoring data from the Coconino NF has documented loss of key habitat components from prescribed fire. Microhabitat monitoring from burns implemented on the Happy Jack Urban Interface Project on the Mogollon Rim Ranger District through late 2004 showed an eight percent loss of trees greater than 18 inches in diameter, a 21 percent loss of snags, a 71 percent loss of down logs, and a 47 percent loss of Gambel oak trees greater than five inches in diameter. In addition, prescribed burns conducted along Highway 87 and Forest Highway 3 (2005-2006) appear to have incurred loss of canopy cover and basal area. These projects did not include PACs and did not have a list of design features developed to minimize loss of key habitat components. Perhaps most important is that the projects being compared had a fuels reduction emphasis rather than the comprehensive restoration goals in the Rim Country Project.

Prescribed burning is expected to reduce the risk of future high-severity fire by reducing accumulations of fuels and raising canopy base height, both of which can benefit wildlife habitat in both the short and long term. However, it can also modify or destroy key habitat components for wildlife. Based upon the sheer number of acres proposed for burning each year, and because the intention is to apply prescribed fire to nearly all PACs and nest/roost recovery acres, there is a likelihood that more key habitat components could be unintentionally lost to fire than modeling indicates. Some degree of unintended fire behavior could improve wildlife habitat by creating canopy gaps and enriching soils. However, effects on habitat could also create adverse effects.

Wildlife Species Analyzed for this Project

Species that are evaluated here are ones known to occur within or have habitat within or adjacent to the project area. Each species from the above groups (such as, ESA, MIS, etc.) that occurs or has the potential to occur within the project area was analyzed according to the applicable law, regulation, or policy. In some cases, surveys for these species have confirmed their presence in or near the project area. In cases where a species has not been detected, the presence of suitable habitat indicates they could be present and therefore their presence was assumed under this analysis.

The following list of federally threatened, endangered, and proposed species is adopted from the USFWS web page (http://www.fws.gov/southwest/es/arizona), accessed on March 22, 2017). This list includes all federally threatened, endangered, candidate, and proposed species in the counties in the Rim Country project area. For the purpose of this analysis, only those federally-listed threatened, endangered, and candidate species and their critical habitat are analyzed. In addition, Forest Service sensitive species that are known to or have the potential to occur within the Rim Country project area are also analyzed. Species that are not present or do not have potential habitat in the project area were dismissed from further analysis as the project would have no effects on these species (Table 56).

Table 56. Threatened, Endangered, and Forest Service Sensitive (TES) Species Evaluated

Common Name	Scientific Name	Status[1]
Chiricahua leopard frog	*Rana chiricahuensis*	T
Northern leopard frog	*Lithobates pipiens*	S
Lowland leopard frog	*Lithobates yavapaiensis*	S
Mexican spotted owl	*Strix occidentalis lucida*	T
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	T
Bald eagle	*Haliaeetus leucocephalus*	S
Northern goshawk	*Accipiter gentilis*	S
American peregrine falcon	*Falco peregrinus anatum*	S
Burrowing owl (western)	*Athene cunicularia hypugaea*	S
Mexican wolf	*Canis lupus baileyi*	E/10j
Navajo Mogollon vole	*Microtus mexicanus Navaho*	S
Western red bat	*Lasiurus blossevillii*	S
Spotted bat	*Euderma maculatum*	S
Allen's lappet-browed bat	*Idionycteris phyllotis*	S
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	S

1. Status: E = Federally Endangered; T = Federally Threatened; E/10j population = Endangered/Experimental population (section (10)(j) of the ESA; Eagle Protection Act = Bald and Golden Eagle Protection Act; S = Forest Service Sensitive.

Table 57. Threatened, Endangered, and Forest Service Sensitive (TES) Species Not Evaluated

Common Name	Scientific Name	Rationale for Dropping	Status[1]
Southwestern willow flycatcher	*Empidonax traillii extimus*	Neither the species nor its habitat occurs in the project area	E
Yuma clapper rail	*Rallus longirostris yumanensis*	Neither the species nor its habitat occurs in the project area	E
California condor	*Gymnogyps californianus*	Neither the species nor its habitat occurs in the project area	E
Narrow-headed gartersnake[2]	*Thamnophis rufipunctatus*	Not Addressed in the Terrestrial Wildlife Species Report	T
Northern Mexican gartersnake[2]	*Thamnophis eques megalops*	Not Addressed in the Terrestrial Wildlife Species Report	T
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Neither the species nor its habitat occurs in the project area	E
Springerville silky pocket mouse	*Perognathus flavus goodpasteri*	Neither the species nor its habitat occurs in the project area	S
Aquatic insects2	Various species	Not Addressed in the Terrestrial Wildlife Species Report	S/MIS

1. Status: E = Federally Endangered; T = Federally Threatened; E/10j population = Endangered/Experimental population (section (10)(j) of the ESA; P = Federally Proposed; S = Forest Service Sensitive; MIS= Management Indicator Species; 2. Analyzed in the Aquatics Specialist Report.

Federally-listed Threatened, Endangered, Proposed and Candidate Species and Critical Habitat

Chiricahua Leopard Frog (CLF)

Listing Status

The Chiricahua leopard frog (*Lithobates [Rana] chiricahuensis*) was listed as threatened without critical habitat on June 13, 2002 (USFWS 2002). A recovery plan for the species was finalized in 2007 (USFWS 2007). Critical habitat was determined in March, 2012. The Rim Country Project Area occurs in Recovery Units 5 and 6.

Range and Life History

The historical range of the Chiricahua leopard frog included portions of west-central and southwestern New Mexico, and central and southeastern Arizona (in addition to portions of Mexico). The number of populations in much of the species' range has declined drastically over the past 20 years.

Within the species' range, aquatic habitats historically and/or currently used by the frogs include a variety of natural and human-constructed waters between elevations of 3,281 and 8,890 feet (1,000 and 2,710 meters), including rivers, permanent streams and permanent pools in intermittent streams, beaver ponds, cienegas (such as, wetlands), springs, and earthen livestock tanks. They are occasionally found in livestock drinkers, irrigation sloughs or acequias, wells, abandoned swimming pools, ornamental ponds, and mine adits (USFWS 2007: 17).

Species Distribution in the Project Area

Chiricahua Leopard Frog (CLF) populations have been detected at various times and locations since 1995 in the action area. Ellison and Lewis Creek in the Upper Verde Management Area (MA) is NE of Payson, AZ. Crouch, Gentry, and Cherry Creeks, and Parallel Canyon in the Gentry Creek MA is NE of Young, AZ. Both areas have CLF populations within and near these drainages (Figure 82). During 2010-2016, observers detected frogs at 19 sites in the Upper East Verde MA because of favorable monsoons, although water permanency has decreased. Also, 2011 had the most significant monsoon. Recovery activities by state and federal agencies contributed to frog detections throughout those years. (Akins 2018, pers. comm). Since then, recent on-the-ground recovery actions by the Local Recovery Group and documentation of natural dispersal to new sites have contributed to maintaining occupied sites across the project area; this includes six populations in designated critical habitat locations.

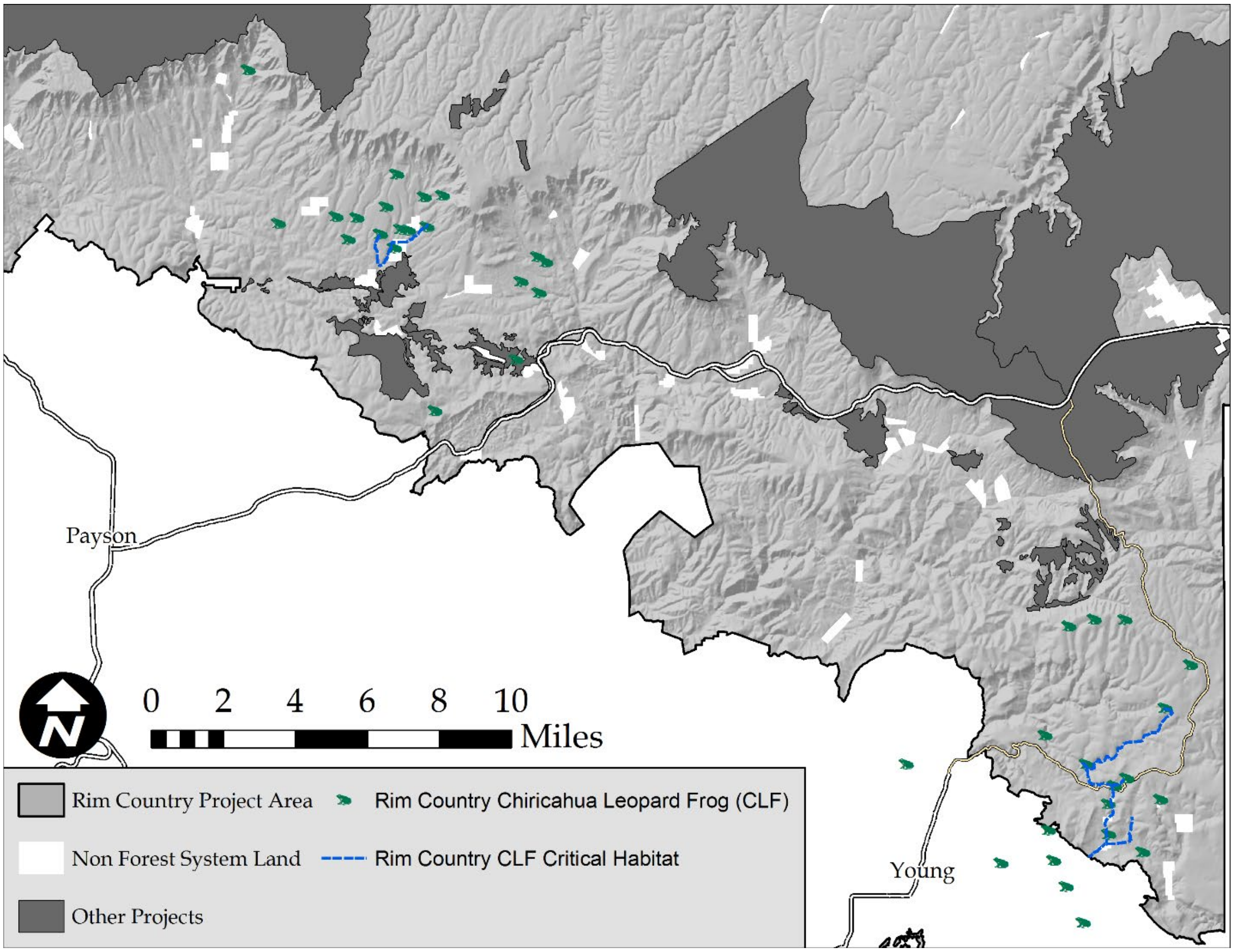

Figure 82. Occupied CLF Habitat within the Project Area

The CLF Recovery Plan identifies suitable habitat to include all perennial waters within: 1) elevational range of the frog (3,400 to 9,000 feet), 2) a mixture of aquatic and perimeter vegetation to provide oviposition sites, thermoregulation, and refuge from predators, 3) absence or low densities of nonnative aquatic species, and 4) a variety in substrate and range of shallow to deeper water for potential hibernacula (USFWS 2007).

Critical Habitat and Primary Constituent Elements in the Project Area

Based on observations of various ranids in Arizona and New Mexico (USFWS 2007: 14-15), reasonable dispersal distances for the species are: (1) one mile overland, (2) three miles along intermittent drainages, and (3) five miles along permanent water courses (USFWS 2007: D-2, 3). In 2012, the FWS designated 10,348 acres in Arizona, New Mexico, and Mexico as CLF critical habitat. This critical habitat falls within eight recovery units (RUs) and is made of 39 units of critical habitat. Two are in the project area. The Ellison and Lewis Creek Unit encompasses a small portion of the westernmost portion of the Apache-Sitgreaves National Forests and also portions of the Tonto and Coconino National Forests. The Crouch, Gentry and Cherry Creeks and Parallel Canyon Unit is on the Tonto National Forest.

Mexican Spotted Owl (MSO)

Listing Status

The MSO was listed as a threatened species under the ESA in March 1993 (USDI FWS 1993). A detailed account of the taxonomy, biology, and reproductive characteristics of the MSO is found in the Final Rule listing the MSO as a threatened species (USDI FWS 1993), in the Recovery Plan (USDI FWS 1995), and in the Revised Recovery Plan (USDI FWS 2012). Information on MSO in the Upper Gila Mountain Recovery Unit (UGM) is also summarized in Ganey et al. (2011). The information provided in these documents is incorporated here by reference as summarized below.

The FWS recommends recovery actions concentrate on recovery units with the highest owl populations (USDI FWS 2012). The UGM supports over half the known population of MSOs (Ganey et al. 2011). Owls appear to be more continuously distributed in the UGM, relative to other Recovery Units, and the central location of the UGM within the overall range of the MSO facilitates gene flow across their range (Figure 84). Therefore this Ecosystem Management Unit is important to the overall range-wide stability of MSOs. Modeling and Habitat Evaluation.

The 2012 Revised Recovery Plan (USFWS 2012) and individual forest plans describe the different levels of MSO habitat management, including protected, recovery, and other forest and woodland types. The stated objectives for managers are to ensure a sustained level of owl nest/roost habitat well distributed across the landscape and create replacement owl nest/roost habitat where appropriate while achieving a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species.

Species Distribution in the Project Area

Delineating MSO Habitat in the Rim Country Project Area

Following Recovery Plan direction, individual forest plans direct managers to conduct a districtwide or larger landscape analysis to ascertain whether minimum recommendations for nest/roost habitat exist across the forest. One of the strengths of landscape-scale planning is the ability to compare habitat across ecological scales as encouraged in the Recovery Plan.

A new recovery layer was created within the Rim Country project area, including designation of recovery nest/roost and foraging habitat as described in the Recovery Plan. This landscape-scale approach better meets the goal of providing continuous replacement nesting and roosting habitat over space and time, as described in the Recovery Plan.

Pine-oak habitat on the Tonto contains mostly ponderosa pine-Gambel oak to the east and pine –evergreen oak to the west. PACs and recovery habitats on the Tonto NF could not all be characterized as pine-oak or mixed conifer and so required queries using additional criteria. A geophysical model (GM) was used to identify recovery habitats based on slope and aspect (modeled recovery habitat). We also assumed that most canyons and drainages would contain some ponderosa pine.

The results of the queries were reviewed in meetings with biologists with on-the-ground familiarity of the Tonto, Coconino and Apache-Sitgreaves National Forests. This review was to ensure that stands also provided the best functional habitat; for example, stands were dropped from consideration when:

1. Remotely-sensed data was found to misidentify juniper as oak in the understory (this was a problem on the Payson Ranger District).
2. Small bubbles of isolated habitat were identified.

Proximity to PAC habitat was also an evaluation criterion. We sought to either augment PAC habitat or designate recovery habitat in previously undesignated pine-oak stands. Fire potential was also considered in developing the spatial configuration of MSO habitat on the landscape. Predominant winds are from the southwest, so we rarely identified additional owl habitat southwest of existing PACs unless stands were on northerly aspects. Because of the fire potential, areas southwest of PACs were revaluated for treatments that would reduce the risk of high-severity fires entering PACs. A final emphasis was placed on removing stands misclassified as recovery habitat.

Habitat criteria for nest/roost habitat was met for 39,461acres and 188,533 acres was designated as other recovery habitat as defined in the Recovery Plan (Table 58). All of the mixed conifer in the project area is recovery habitat.

Table 58. Acres of Mexican Spotted Owl (MSO) Habitat

MSO Habitat	Apache-Sitgreaves Acres	Coconino Acres	Tonto Acres	Total Acres
Protected Activity Center (Protected Habitat)	35,081 acres (56 PACs)	48,310 Acres (94 PACs)	27,498 Acres (46 PACs)	110,890 Acres (196 PACs)
Nest/Roost Recovery Habitat – Pine Oak	4,180	11,033	5,513	20,726
Foraging/Non-Breeding Recovery Habitat – Pine Oak	33,139	61,971	30,107	125,217
Nest/Roost Recovery Habitat – Mixed Conifer	6,700	6,019	1,688	14,407
Foraging/Non-Breeding Recovery Habitat – Mixed Conifer	8,923	18,837	3,285	31,045
Nest/Roost Recovery Habitat - Geo Phys Model	NA	NA	4,328	4,328
Foraging/Non-Breeding Recovery Habitat - Geo Phys Model	NA	NA	32,271	32,271
% Geo Phys Model Recovery Nest/Roost Recovery Habitat - Geo Phys Model	NA	NA	11%	11%
Total MSO Recovery Acres	52,942	97,860	77,192	227,994
Total MSO Habitat Acres	88,023	146,170	104,690	338,884

A similar process was initiated to consider the potential for specialized treatments inside PACs. A total of 196 PACs (110,890 acres) occur in the Rim Country project area, with 94 on the Coconino, 56 on the Apache-Sitgreaves National Forests and 46 PACs on the Tonto National Forest. An additional 39,748 acres either fall outside of the Rim Country boundary area (11,269 acres) or occur in other project areas (28,479 acres). These 39,748 acres would be treated as those projects planned and consulted with FWS. Twenty nine of these PACs would have some other type of restoration (riparian, wet meadow, grassland, aspen, etc. see Actions common to Alternatives 2 and 3 below). In the 4 FRI Rim Country project area up to 82,411 acres are proposed for other thinning and/or burning, or other restoration activities in Alternatives 2 and 3 (see Effects Analysis sections below).

Once the status of the PAC was determined, potential mechanical treatments were considered in terms of whether they could:

- Decrease the amount of time required for growing/increasing tree height and diameter;
- Decrease overall tree density while maintaining the density of large trees, and
- Increase canopy base height to improve flight zone (such as, improve owl foraging ability) and also reduce the threat of surface fires becoming crown fires.

It was determined that 12 of the 196 PACs assessed did not need mechanical treatments, and that mechanical treatments were possible in 24,875 acres of PACs. One hundred and seventy-one (171) miles of stream restoration, 2,881 acres of riparian restoration, and 489 acres of grassland/meadow restoration were identified in PACs. PACs were not considered for treatment if they were treated in previous projects, or if their habitat was not suitable for Rim Country treatments (some occur in designated wilderness or canyons, were previously burned, have conditions inside and outside the PAC that do not need active management, or there is not enough information to identify a need for treatment). Prescribed fire only was recommended for 49,066 acres in PACs, including using prescribed fire in core areas.

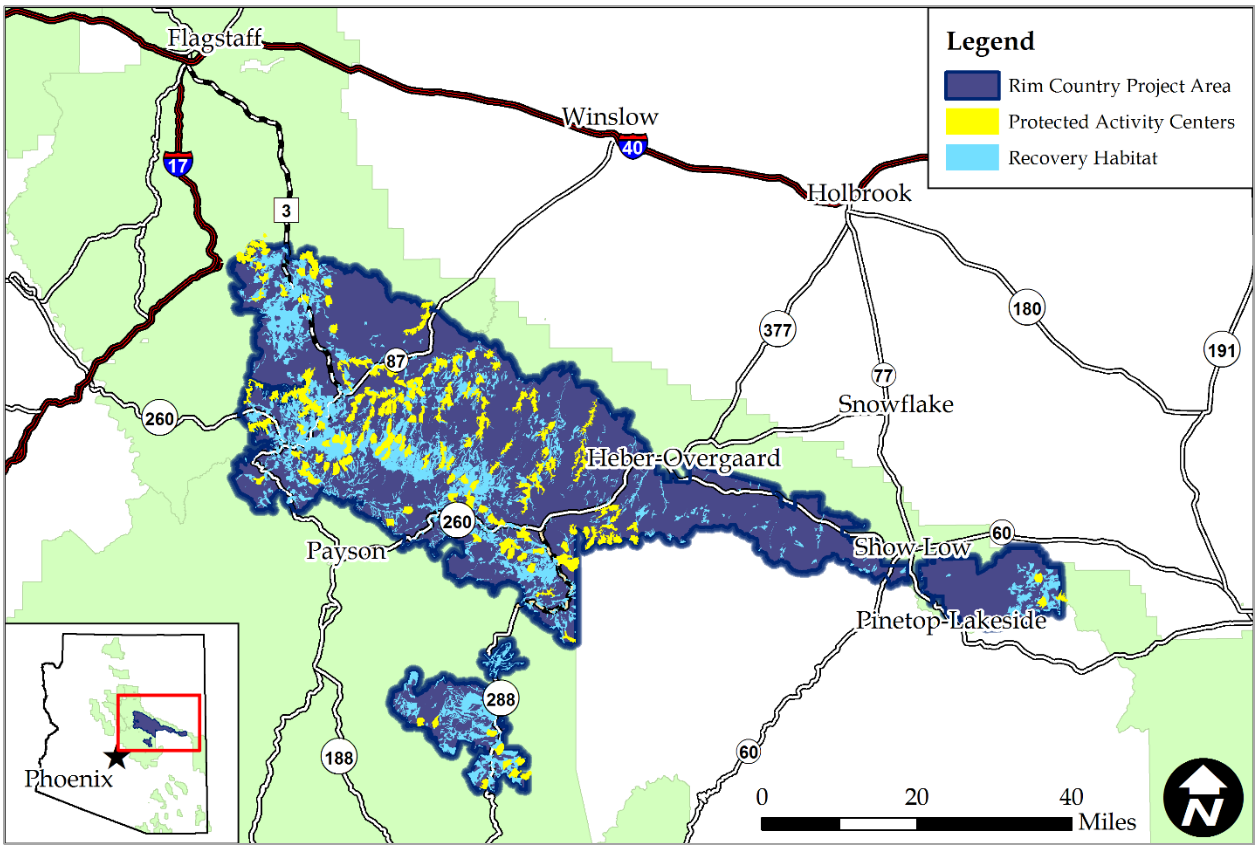

Figure 83. Mexican spotted owl habitat

Critical Habitat and Primary Constituent Elements in the Project Area

MSO critical habitat was designated by the FWS in 2004 (USDI FWS 2004). Critical habitat is defined as protected and recovery habitats within designated areas which contain the primary constituent elements (PCEs) necessary for conservation of the species (USDI FWS 2004). A detailed list of PCEs can be found in the Evaluation Criteria section below.

Two critical habitat units occur partially or completely within the Rim Country project area (Figure 84). They encompass 488,974 acres of Forest Service land, including mixed-conifer forest, but do not include state, private, Naval Observatory, or certain wildland-urban interface areas. A total of 266,149 acres of MSO habitat occurs within the critical habitat units in the Rim Country project area. In addition, non-MSO habitat occurs within critical habitat units and designated MSO habitat occurs outside of critical habitat units (72,735 acres).

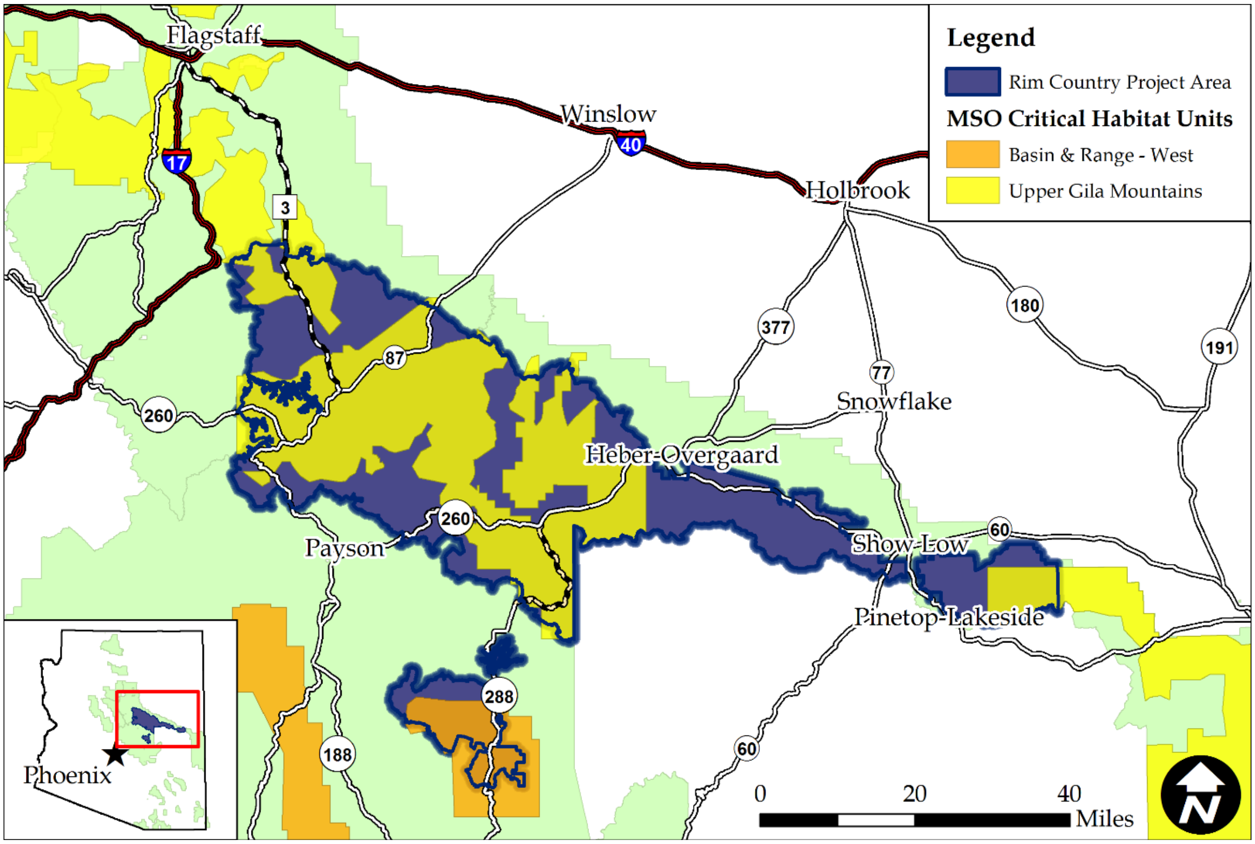

Figure 84. Mexican Spotted Owl critical habitat units

Western Yellow-billed Cuckoo (WYBCU)

Listing Status

The western distinct population segment of the yellow-billed cuckoo was listed as a threatened species under the ESA on October 3, 2014 (USFWS 2013, 2014b; 78 FR 61622, 79 FR 59992). Within the population segment (see Figure 1 at 79 FR 59994, in the final listing rule (79 FR 59992; October 3, 2014)), the habitat areas used by the species for nesting are located from southern British Columbia, Canada, to southern Sinaloa, Mexico, and may occur from sea level to 7,000 feet (ft.) (2,154 meters (m)) in elevation (or slightly higher in western Colorado, Utah, and Wyoming). Critical habitat for the yellow-billed cuckoo population segment was proposed on August 15, encompassing 546,335 acres across the western United States (USFWS 2014a; 79 FR 48548). The discussions of the status of this species in these documents are incorporated herein by reference. A revised proposed rule that may include additional proposed critical habitat is under development.

Range and Life History

In Arizona, the species was a common resident in the (chiefly lower) Sonoran zones of southern, central, and western Arizona (Phillips et al. 1964). The yellow-billed cuckoo now nests primarily in the central and southern parts of the state, as well as at revegetation sites along the lower Colorado River (MacFarland and Horst 2015; USFWS 2013, 2014a, 2014b, McNeil et al. 2013). In the Southwest, the Western yellow-billed cuckoo (WYBC) usually occurs in association with large blocks of mature riparian cottonwood-willow woodlands and dense mesquite associations (USFS 2011a). Habitat features of the WYBC indicate a preference for areas with a closed canopy and a sub-canopy layer (USFS 2011a). Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California (USFS 2011a). Nesting west of the Continental Divide occurs almost exclusively close to water (USFWS 2001).

Species Distribution in the Project Area

The western distinct population of the yellow-billed cuckoo is not known to occur in the project area. No critical habitat areas have been identified within the Rim Country project area for the cuckoo, though proposed critical habitat units are seven miles east and south of the project area.

There have been no systematic surveys for the WYBCU on the Apache-Sitgreaves National Forests; however, there are some incidental known occurrences, all of them on the Apache side. The cottonwood-willow riparian forest cover type occurrence on the Sitgreaves side of the Apache-Sitgreaves National Forests is not likely to provide habitat extensive enough for nesting. On the Tonto National Forest, in previous years there have been detections of cuckoos in Rye Creek on the Payson-Tonto Basin border near Rye and Gisela creeks Cuckoos have also been found along the Verde River and Cherry Creek (Tonto Basin portion). It is possible that cuckoos could be present in some of the drainages in the Rim Country footprint.

Proposed Critical Habitat and Primary Constituent Elements in the Project Area

The 4 FRI Rim Country Project area does not contain proposed critical habitat for Yellow-billed Cuckoos, but it is likely that the species does occur here. Critical habitat Unit 19, Beaver Creek, is approximately seven miles east of the project area and Unit 22 (Tonto Creek) is approximately seven miles southeast of the project area.

3. Primary Constituent Element 1—Riparian woodlands. Riparian woodlands with mixed willow cottonwood vegetation, mesquite-thorn forest vegetation, or a combination of these that contain habitat for nesting and foraging in contiguous or nearly contiguous patches that are greater than 325 ft. (100 m) in width and 200 ac (81 ha) or more in extent. These habitat patches contain one or more nesting groves, which are generally willow dominated, have above average canopy closure (greater than 70 percent), and have a cooler, more humid environment than the surrounding riparian and upland habitats.
4. Primary Constituent Element 2—*Adequate prey base*. Presence of a prey base consisting of large insect fauna (for example, cicadas, caterpillars, katydids, grasshoppers, large beetles, dragonflies) and tree frogs for adults and young in breeding areas during the nesting season and in post-breeding dispersal areas.
5. Primary Constituent Element 3—*Dynamic riverine processes*. River systems that are dynamic and provide hydrologic processes that encourage sediment movement and deposits that allow seedling germination and promote plant growth, maintenance, health, and vigor (for example, lower gradient streams and broad floodplains, elevated subsurface groundwater table, and perennial rivers and streams). This allows habitat to regenerate at regular intervals, leading to

riparian vegetation with variously aged patches from young to old. Because the species exists in disjunct breeding populations across a wide geographical and elevational range and is subject to dynamic events, the river segments described below are essential to the conservation of the western yellow-billed cuckoo, because they maintain stability of subpopulations, provide connectivity between populations and habitat, assist in gene flow, and protect against catastrophic loss. The occupied rivers and streams that are proposed for designation contain physical and biological features that are representative of the historic and geographical distribution of the species. All river segments proposed as western yellow-billed cuckoo critical habitat are within the geographical area occupied by the species as defined by the species' DPS at the time of listing (such as, currently) and contain the features essential to the conservation of the species. The features essential to the conservation of the species and refined primary constituent elements are present throughout the river segments selected, but the specific quality of riparian habitat for nesting, migration, and foraging would vary in condition and location over time due to plant succession and the dynamic environment in which they exist.

Mexican Wolf

Listing Status

The Mexican wolf, *Canis lupus baileyi*, is an endangered subspecies of gray wolf protected by the Endangered Species Act (80 FR 2488, January 16, 2015) (ESA). On January 12, 1998, the U.S. Fish and Wildlife Service published an Endangered Species Act section 10(j) rule for the Mexican wolf that provided for the designation of specific populations of listed species in the United States as "experimental populations". The Mexican wolf has been reintroduced on national forests in Arizona and New Mexico. These wolves have been designated as a non-essential experimental population, pursuant to section 10(j) of the Endangered Species Act as amended.

Wording from the USFWS 2014 EIS for the proposed revision to the Regulations for the Non-essential experimental population of the Mexican Wolf.

Disturbance-causing land-use activity means any activity on Federal lands within a 1-mi (1.6-km) radius around release pens when Mexican wolves are in them, around active dens between April 1 and July 31, and around active Mexican wolf rendezvous sites between June 1 and September 30, that the Service determines could adversely affect reproductive success, natural behavior, or persistence of Mexican wolves. Such activities may include, but are not limited to—timber or wood harvesting, prescribed fire, mining or mine development, camping outside designated campgrounds, livestock husbandry activities (for example, livestock drives, roundups, branding, vaccinating, etc.), off-road vehicle use, hunting, and any other use or activity with the potential to disturb wolves. The following activities are specifically excluded from this definition:

i. Lawfully present livestock and use of water sources by livestock;
ii. Livestock drives if no reasonable alternative route or timing exists;
iii. Vehicle access over established roads to non-Federal land where legally permitted activities are ongoing if no reasonable alternative route exists;
iv. Use of lands within the National Park or National Wildlife Refuge Systems as safety buffer zones for military activities and Department of Homeland Security border security activities;
v. Fire-fighting activities associated with wildfires; and
vi. Any authorized, specific land use that was active and ongoing at the time Mexican wolves chose to locate a den or rendezvous site nearby.

Thinning and burning projects have the potential to affect wolves, especially when reproduction and denning activities are disrupted. The Forest Service would work closely with the wolf field team to identify sensitive areas and avoid temporal disruptions that could negatively affect Mexican wolves.

Range and Life History

The Mexican wolf is a top predator native to the southwestern United States and Mexico that lives in packs and requires large amounts of forested terrain with adequate ungulate (deer and elk) populations to support the pack. Predator eradication programs in the mid to late 1800's to mid-1900's resulted in the near extinction of the Mexican wolf. Extinction was averted with the inception of a captive breeding program founded with seven Mexican wolves.

In the United States, Mexican wolves were reintroduced to the wild in 1998 in the Mexican Wolf Experimental Population Area, an area designated for Mexican wolf reintroduction in Arizona and New Mexico. The Mexican wolf population in this population area has exhibited robust growth in recent years. As of December 31, 2016, a population of at least 113 wild Mexican wolves inhabited the population area, the largest population size reached to date (USFWS 2017b).

The threats to the Mexican wolf have generally remained consistent over time, including human-caused mortality and related legal protections, extinction risk due to small population size, and loss of genetic diversity (USFWS 2017).

Species Distribution in the Project Area

Figure 85 shows areas of potential wolf habitat and includes parts of the Rim Country planning area classified as high quality. Radio-collared wolves on the Black Mesa District of the Apache-Sitgreaves National Forests have recently been located within the Rim Country boundary (USFS 2017), before returning to the east. In 2018, another lone male passed through Rim Country from the Gila Wilderness in NM to the Kaibab National Forest west of Flagstaff. Also in 2018, un-collared wolves were confirmed in the Heber/Overgaard area. Given wolves' capacity for long-distance dispersals (Mech et al 1995), we could reasonably predict that more individuals could occur within the Rim Country project area during the planning and implementation of the project. Coordination between the Forest Service and the Inter-Agency Field Team (IFT) would occur before phases of implementation to verify wolf occurrences in projects area.

The following figure is from Martínez-Meyer et al. 2017, Figure 19. Reclassified intermediate habitat suitability scenario for the Mexican wolf based on the combination of climatic suitability, land cover use, human population density, and road density.

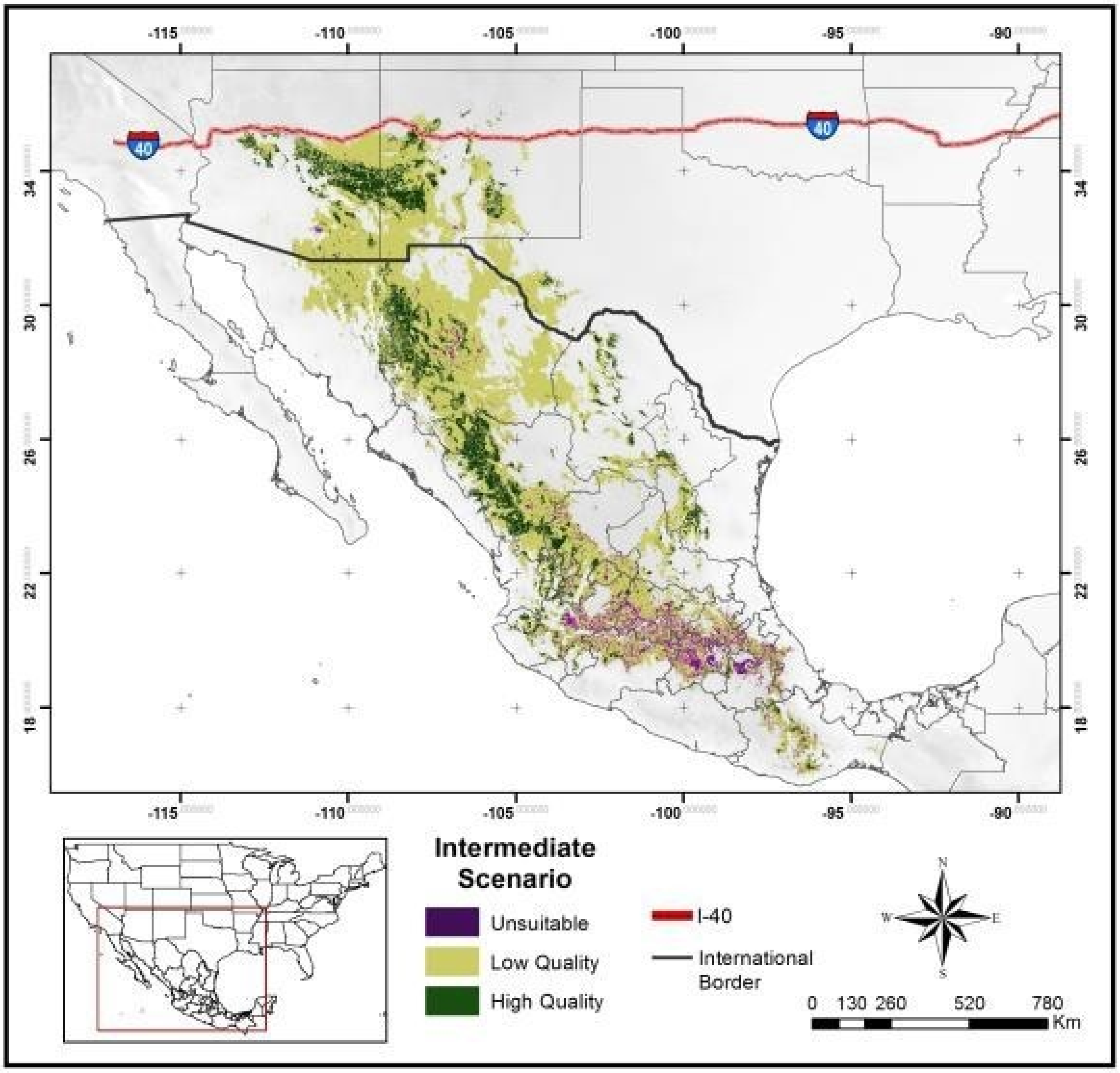

Figure 85. Focal area for Mexican wolf recovery strategy, including the MWEPA in the United States, and the Sierra Madre Occidental in Mexico

Forest Service Sensitive Species

Sensitive species are defined as "those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: (a) significant current or predicted downward trends in population numbers or density, or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5(19))."

The most recent Regional Forester's Sensitive Species list was transmitted to Forest Supervisor's in September 2013 and is the basis for the species used for this analysis. If survey information was not available, the assumption was made that potential habitat was occupied. The presence of species carried forward for analysis was determined by consulting forest records, results of surveys conducted on the forest, and use of the FAAWN database (Patton 2011) and NRM.

Thirteen RFSS occur within the project area. In-depth descriptions of these species and further information can be found in the Wildlife Specialist Report. The Northern Goshawk and analysis for this species is included below because key issues were raised by the public regarding treatment in goshawk habitat.

Northern Goshawk (NOGO)

This analysis addresses policy requirements and responds to key issues raised by the public including Issue 2, Treatments in Goshawk Habitat and Issue 3, Large Tree Retention. Indicators include changes in the amount and/or quality of goshawk nesting and post-fledging family area (PFA) habitat. Specific measures include:

6. Acres treated by habitat/vegetation type by alternative in PFAs and areas outside of PFAs.
7. Changes in tree size-classes by alternative in PFAs and areas outside of PFAs.
8. Percent canopy cover by alternative in PFAs and areas outside of PFAs.
9. Number per acre of snags logs, and tons per acre coarse woody debris in PFAs and areas outside of PFAs.
10. Changes in percent shrub and herbaceous biomass (to maintain fruits, seeds, and regeneration to provide needs of goshawk prey species) in PFAs and areas outside of PFAs.
11. Changes in potential fire behavior (Fire Hazard Index) by alternative in PFAs.
12. Changes in risk of crown fire by alternative in PFAs.

This report utilizes and incorporates by reference the vegetation cover type and vegetation existing condition information provided in the Silviculture Report and the respective forestwide MIS reports.

Forest Plan Compliance and Analysis Framework

Forest plan direction for northern goshawks applies to goshawk habitat outside of Mexican spotted owl habitat. In ponderosa pine forest, one or the other set of guidance applies and Mexican spotted owl guidance takes precedence in areas of overlap.

Habitat Strata and Scales of Analysis

PFAs are about 600 acres in size (including the nest areas, replacement nest areas, and habitat most likely to be used by fledglings during early development). PFAs were considered occupied. The Coconino Revised Forest Plan (2018), Tonto Forest Plan (1985), and A-S Revised Forest Plan (2015) have direction to include a minimum of six nest areas and replacement nest areas within each PFA. Nest areas would be about 25 to 30 acres in size (minimally 30 acres (Coconino National Forest)), and based on active nest sites followed by the most recently used historical nest sites.

Goshawks and Rim Country

There are 106 PFAs on the Coconino, Tonto, and A-S National Forests, totaling 60,180 acres in the Rim Country project area. Of these acres, 22,320 are within other project areas (Figure 86). Approximately 37,860 acres of PFA habitat would be treated with mechanical thinning and/or prescribed fire in the proposed action. A PFA was only counted once if a portion of that PFA occurs on more than one forest. Figure 86 shows the distribution of goshawk PFAs in the Rim Country project area. The Rim Country Flexible Toolbox Approach for Mechanical Treatments identifies PFAs as areas where special prescriptions would promote habitat variables needed by this species.

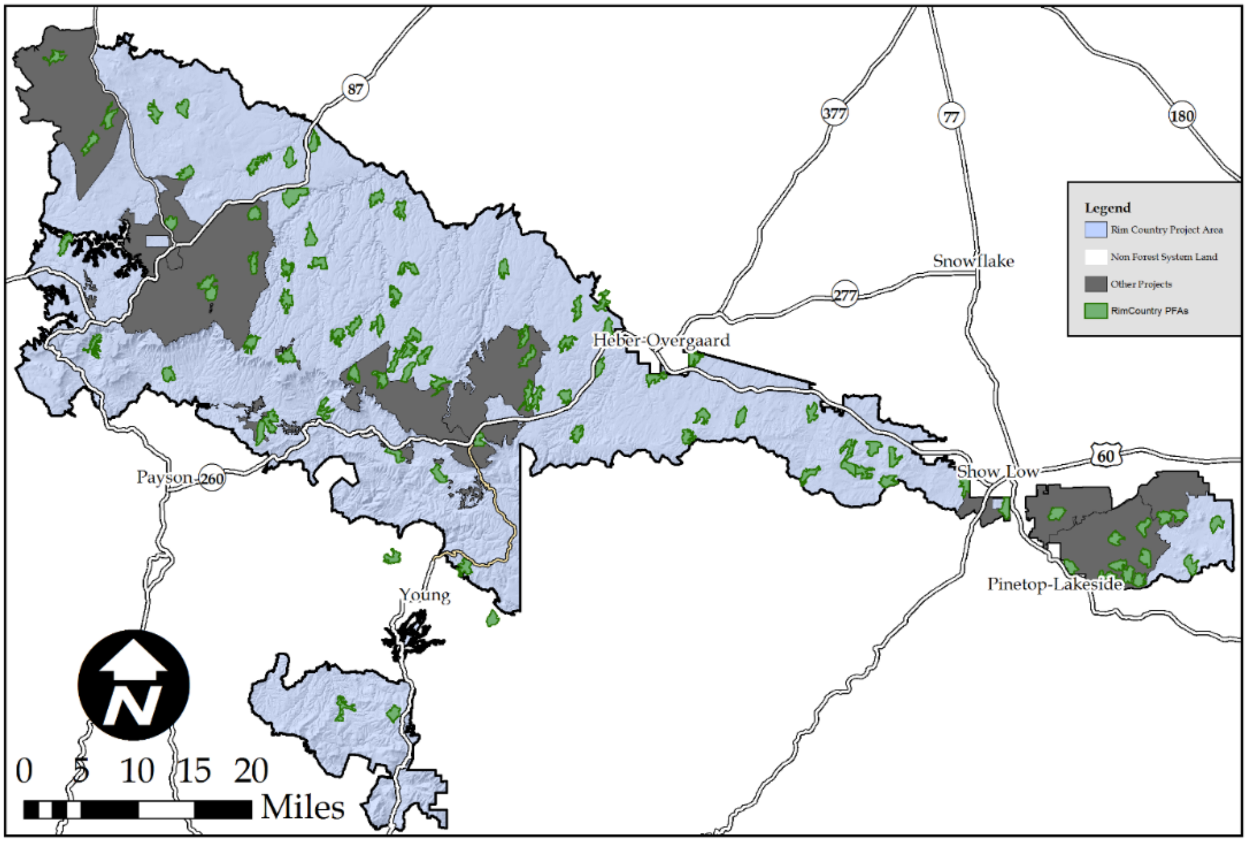

Figure 86. Goshawk PFAs

Bald Eagle

The FWS removed the bald eagle in the lower 48 States of the United States from the Federal List of Endangered and Threatened Wildlife as of August 8, 2007 (USDI FWS 2007d). Eagles are currently protected under the Golden and Bald Eagle Protection Act and are a Forest Service sensitive species.

The FWS recommends using the Conservation Assessment and Strategy for Bald Eagles in Arizona (Driscoll et al. 2006) in conjunction with the Bald Eagle National Management Guidelines (USDI FWS 2007e) to protect bald eagles in Arizona. These guidelines were incorporated into the Rim Country as design features or mitigation.

Bald eagles in central Arizona prefer to nest on cliff ledges or pinnacles or in tall trees (USDI FWS 1982). Bald eagles are habitat generalists and opportunistic feeders, typically taking the easiest and most abundant prey, regardless of whether it is dead or alive (Joshi 2009). They mainly forage on waterfowl and fish found along major streams; however, they do hunt in the uplands and forage on various mammal species, especially in the winter.

Nesting

Bald eagle numbers in Arizona have increased since 2008, with the number of breeding areas recorded increasing from 56 in 2008 to 85 in 2017. Active breeding areas increased from 44 in 2008 to 60 in 2017. The number of young fledged has increased from 53 in 2008 to 63 in 2017. Nesting success is partially attributed to the AZGFD Bald Eagle Nest Watch Program and to Forest Service closures around nest sites (Show Low Lake and Chevelon Canyon on the Apache-Sitgreaves National Forests).

There are seven nesting pairs of bald eagles within or near the project area (Table 59. Bald Eagle nests).

Table 59. Bald Eagle nests

Breeding Area	Location: Forest/Ranger District	Status in 2018/Recent Nesting History
Fool Hollow Lake	A-S, Lakeside	Active Nest in 2018.
Chevelon Canyon Lake	A-S, Black Mesa	Unknown. Successful nest in 2016, 2 fledged.
76	Tonto, Tonto Basin RD	Active. Successful nest in 2016, 2 fledged.
Silver Creek	Private, Adjacent to Tonto NF, Payson	Active. 2 fledged in 2015. Active nest in 2018.
Show Low Lake	A-S, Lakeside	Active.
Woods Canyon	A-S, Black Mesa	Active. 1 fledged in 2016, 1 fostered from Show Low Lake. Fledged 1 in 2018.
O.W. / Canyon Creek	Tonto, Pleasant Valley	Unknown. First nest attempt in 2018, nest failed.

Wintering

Bald eagles occurring on the Coconino and Apache-Sitgreaves National Forests are primarily winter visitors. Bald eagles overwintering in northern Arizona are primarily migratory individuals that breed in the northern U.S. and Canada (Grubb et al. 1989). They are often seen scavenging on carrion, including large and small mammals, or around some of the waters supporting fish and waterfowl. The AZGFD provided important wintering bald eagle habitat areas to consider for the 4FRI Rim Country analysis. These included the Lakeside Ranger District of the A-S's various lakes: Mogollon Plateau: Lower Lake Mary Road; Rattlesnake Canyon: Lake Mountain, Verde River Valley, Wingfield Mesa, Mogollon Plateau, Jack's Canyon; Mogollon Plateau: Slim Jim Ridge; Mogollon Rim: West Chevelon Canyon; Chevelon Canyon Lake; Mogollon Rim: Cottonwood Wash; Sierra Anchas: Dupont Canyon; Willow Springs Lake; and the Buckhead Mesa Landfill.

Small to moderate-sized groups of bald eagles (typically two to 48) roost in clumps of large trees in protected locations such as drainages and hillsides (Grubb and Kennedy 1982, Dargan 1991, Grubb 2003). Bald eagle winter night roosts typically consist of clumps of large (average diameter at breast height of 30 inches) trees on steep slopes that tend to occur on east-facing aspects (Joshi 2009). Group sites are typically in stands of ponderosa pine trees of less than an acre up to 43 acres, most often on north or northeast-facing slopes close to daytime foraging areas (Dargan 1991). Day roosts are often trees or snags near water or roadways. Bald eagles are highly mobile in the winter and can fly great distances in search of aquatic or terrestrial prey and suitable nighttime roosting habitat.

Golden Eagle

Golden Eagle nesting within the Rim Country project area has been recorded on the eastern boundary on the Verde River, outside of the project area on Deadman's Mesa and approximately 2 miles north of the project area on the Tonto National Forest, Pleasant Valley Ranger District. South of the project area in the Sierra Anchas, 7 Golden Eagle historic and active nest sites are within 1 to 3 miles of the project area. Approximately three miles north of Rim Country on the Apache-Sitgreaves National Forest, Black Mesa District there is an active nest site (2015) North of Heber, AZ. in Black Canyon and another NE of Chevelon Crossing.

Forest Service Management Indicator Species

The 2018 Coconino Revised Forest Plan identifies three wildlife species as management indicator species (MIS) to monitor ecosystem health. The 2015 Apache-Sitgreaves Revised Forest Plan also identified three focal species which were analyzed and will be monitored at the Forest level. The current Tonto National Forest Plan identifies 28 wildlife MIS, with 18 species known or assumed to occur within the Rim Country project area.

The 2018 Coconino Revised Forest Plan identifies three wildlife species as management indicator species (MIS) to monitor ecosystem health. The 2015 Apache-Sitgreaves Revised Forest Plan also identified three species. The current Tonto National Forest Plan identifies 28 wildlife MIS, with 18 species known or assumed to occur within the Rim Country project area.

The proposed project would affect ponderosa pine, mixed conifer, aspen, pinyon-juniper, grassland/savannah, ephemeral streams, and spring habitats. MIS or their respective habitat components that do not occur within the proposed Rim Country project area would not be analyzed. The presence of species carried forward for analysis was determined by surveys conducted on the forests and the FAAWN (Forest Attributes and Wildlife Needs) database (Patton 2011).

Eighteen MIS whose distribution across the Rim Country National Forests encompasses part or all of the project area are included in the terrestrial effects analysis (Table 60). The analysis is also based on forest plan direction and projected changes in quality habitat under the alternatives.

Table 60. Terrestrial Management Indicator Species (MIS) or Focal Species Analyzed

Management Indicator Species	Forest(s)	Key MIS Habitat Component Indicator	Habitat within Project Area
Pronghorn antelope (*Antilocapra americana*)	Coconino	Great Basin grassland, montane-subalpine grassland	Montane–subalpine grassland
Mexican spotted owl (*Strix occidentalis lucida*)	Coconino	Late-seral pine-oak, dry/wet mixed conifer and spruce-fir	Ponderosa pine–oak, dry mixed conifer
Northern goshawk (*Accipiter gentilis*)	Tonto	Late-seral ponderosa pine	Ponderosa pine
Pygmy nuthatch (*Sitta pygmaea*)	Coconino; Tonto	Late-seral ponderosa pine	Ponderosa pine
Turkey (*Meleagris gallopavo merriami*)	Tonto	Late-seral ponderosa pine, mixed conifer	Ponderosa pine
Rocky Mountain elk (*Cervus elaphus*)	Tonto	Early seral ponderosa pine, mixed conifer, and spruce-fir	Ponderosa pine, mixed conifer
Hairy woodpecker (*Picoides villosus*)	Tonto	Snags in ponderosa pine, mixed conifer and spruce-fir	Snags in ponderosa pine
Abert's squirrel (*Sciurus aberti*)	Tonto	Early seral ponderosa pine	Ponderosa pine
Violet green swallow (*Tachycineta thalassina*)	Tonto	Ponderosa pine; mixed conifer cavities	Ponderosa pine; Mixed conifer
Ash-throated flycatcher (*Myiarchus cinerascens*)	Tonto	Pinyon-juniper woodland	Pinyon-juniper
Gray vireo (*Vireo vicinior*)	Tonto	Pinyon-juniper woodland	Pinyon-juniper
Townsend's solitaire (*Myadestes townsendi*)	Tonto	Pinyon-juniper woodland	Pinyon-juniper

Management Indicator Species	**Forest(s)**	**Key MIS Habitat Component Indicator**	**Habitat within Project Area**
Juniper (Plain) titmouse (*Baeolophus ridgwayi*)	Tonto	Pinyon-juniper woodland	Pinyon-juniper
Northern (Common) Flicker (*Colaptes auratus*)	Tonto	Pinyon-Juniper woodland (snags)	Pinyon-Juniper
Arizona gray squirrel (*Sciuris arizonensis*)	Tonto	Riparian-High Elevation (3000 ft. plus)	General Riparian
Western bluebird (*Sialia mexicana*)	Tonto	Forest openings in ponderosa pine/mixed conifer type	Ponderosa pine-oak, mixed conifer
Western wood peewee (*Contopus sordidulus*)	Tonto	Riparian-High Elevation	Riparian tall overstory
Black hawk (*Buteogallus anthracinus*)	Tonto	Riparian-High Elevation	Riparian tall overstory

Information on species, their population trends, and habitat trends presented in this analysis is incorporated into the wildlife specialist report. Analysis of MIS for the Coconino National Forest (USDA FS 2011), Tonto National Forest Forestwide MIS report (USDA FS 1985a) is also incorporated by reference. For more in depth discussions of habitat types and species selection as well as forest wide population trends, see the Wildlife Specialist Report (USDA FS 1985a).

A discussion of habitats and bird species found in these habitats is included in the Wildlife specialist report.

Important Bird Areas

The Mogollon Rim Snowmelt Draws Important Bird Area is the only one within the project area. It covers approximately 72,162 acres and encompasses drainages located within eight kilometers of the edge of the Mogollon Rim, an abrupt cliff that represents the southern extension of the Colorado Plateau. This edge of the Rim has a narrow band of moist vegetation (especially maples) associated with greater precipitation formed by the upward deflection of air at the rim face. The habitat of this bird area includes ponderosa pine, white fir, Douglas fir, southwestern white pine, quaking aspen, and Gambel oak. Young plants of these canopy trees, plus canyon maple and New Mexico locust, dominate the understory woody species.

See the Arizona Important Bird Areas Program website for more information at http://aziba.org.

About 45,673 acres of habitat would be treated within the project area, equaling about 61 percent of the Important Bird Area. While most acres proposed for treatment are within ponderosa pine habitat, treatments in the Important Bird Area would also occur in mixed conifer, aspen and oak/maple habitats. In addition, road decommissioning, restoration of springs, and over 30 miles of riparian restoration activities are proposed within the area.

Other Species of Concern

Locally Important Species

The Forest Plans of the 4FRI Rim Country forests provide desired conditions and guidelines for the protection of locally important species on each of the forests. Most of the terrestrial species considered rare and endemic on the forests are outside the Rim Country project area. No further documentation is required for the following species except for the Arizona black rattlesnakes and Arizona toad (see wildlife specialist report).

Environmental Consequences

Environmental consequences consist of species analyses, beginning with federally threatened and endangered species followed by Forest Service sensitive species, management indicator species, migratory birds, and effects on Important Bird Areas. Following the analysis of direct and indirect effects for each species group is a review of cumulative effects.

Effects from Climate Change

Alternative 1

Alternative 1 would not prevent, delay, or ameliorate predicted effects from climate change. The dense forest conditions resulting from Alternative 1 are at a high risk to density-related and bark beetle mortality and have limited resilience to survive and recover from potential large-scale fire events and the interactions of these influences with climate change. Under drier and warmer weather conditions, the potential effects of these risks on the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As tree density increases, many areas would experience higher mortality. Species requiring closed canopy forest conditions or old or large tree, snag, and log structure would be negatively affected in the long term. Patches of open forest, savanna, and meadow and grassland habitats would potentially increase in the long term as groups of dense forest succumb to the above mortality agents.

Alternatives 2 and 3

Risks associated with dense forest conditions would be reduced and resilience to the effects from large-scale disturbance under drier and warmer conditions would be improved by implementing the proposed treatments. Individual tree growth rates would improve, creating and retaining more large and old trees. Habitat elements associated with closed canopy forest conditions would be reduced, but would be more sustainable. Risk from insects, fire, and their interactions with climate would be reduced. Because of law, regulation, and policy, more closed canopy habitat would be available than what likely occurred historically. Ensuring the growth and retention of large trees would maintain large snag and log structure across the forest over time. Open forest, meadow, savanna, and grassland habitats would be enhanced and habitat effectiveness increased as encroaching trees were removed and habitat for grassland and pollinator species became less fragmented. These habitats would remain stable in the long term. The increased acres of mechanical and prescribed fire under Alternative 2 would realize the most benefit in terms of forest health and resiliency. The limited acres of treatment under Alternative 3 would be expected to maintain higher fuel loadings, resulting in more limited gains in forest resiliency due to increased flame lengths, lower canopy base height, and persistent ladder fuels. Alternative 3 would retain the densest forests and therefore achieve the least in terms of large tree growth rates and resilience.

Federally Listed Threatened, Endangered, Proposed, and Candidate Species and Critical Habitat

Chiricahua Leopard Frog (CLF)

Alternative 1 (No Action)

Under Alternative 1, habitat conditions for wildlife would largely remain in their current condition. Thinning and prescribed fire would still occur in RU 5 as a result of current and reasonably foreseeable projects. However, the landscape would continue to move away from desired conditions (see Affected Environment above and the Silviculture and Fire Ecology and Air Quality Reports). Alternative 1 would have no direct effect on Chiricahua leopard frogs; however there would be substantial indirect effects. Dense forest conditions would still occur and the high fire hazard potential would persist. Large crown-wildfires could adversely affect potential habitat by destroying understory and overstory vegetation. As a result, overland flow would increase, and soil erosion would increase, with potentially high sediment loads. Water quality and riparian conditions would be adversely affected on a wide-scale basis (see Water and Riparian Resource Report), resulting in indirect adverse effects.

With Alternative 1, there would be no restoration of springs and riparian areas. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (see Water and Riparian Resource Report), resulting in degradation of potential habitat for frogs.

Denser forest conditions produce lower values in understory biomass (pounds per acre). Under Alternative 1, understory biomass would continue to decline over the next 40 years. Limited cover around tanks and riparian areas, as well as the limited herbaceous understory across the project area, would continue to reduce the likelihood that frogs would successfully disperse and feed while traveling between waters. The limited cover would also leave frogs vulnerable to predation.

Cumulative Effects

The area analyzed for cumulative effects for northern leopard frogs is RU 5 within the project area and a 0.25-mile buffer outside of the project boundary, along RU 5 to include current and potential breeding sites. Cumulative effects include the effects from Alternative 1. This alternative would continue to result in indirect effects on Chiricahua leopard frogs. Degradation of habitat facilitated by this alternative would cumulatively combine with other forest activities, high-impact recreational use, livestock grazing, and habitat loss and degradation on private lands. Synergistic effects from climate change would continue to fragment key aquatic and dispersal habitat.

Critical Habitat

Two critical habitat management area units are within the action area: the Ellison and Lewis Creek management area and the Crouch, Gentry, Cherry Creeks, and Parallel Canyon management area. No change is expected to occur in these management area units under the no action alternative.

Determination of Effect

Alternative 1 may **affect** and is likely to adversely affect the Chiricahua leopard frog and designated critical habitat.

Effects Common to All Action Alternatives

Alternatives 2 and 3 would allow discharge from springs to resume flow through their historic spheres of discharge. Restoration implementation would increase riparian vegetation increasing availability of food and reproductive sites for this species over the long term, resulting in direct beneficial effects on habitat. Restoration would improve cover and water flow that provides escape from predators and prevents water loss for migrating leopard frogs.

Alternative 2 – Modified Proposed Action

Direct and Indirect Effects

Leopard frogs dispersing overland could be directly affected if they are inadvertently run over by mechanical equipment or if they could not find refugia during prescribed fire activities. All suitable habitat would be surveyed prior to restoration activities. Design features (see below and Appendix 5 of the wildlife specialist report) would reduce the likelihood of direct effects on frogs from mechanical thinning, temporary road construction, spring and riparian restoration, road decommissioning, and prescribed fire.

Under the modified proposed action, dense forest conditions and surface fuel loading in RU 5 would be reduced. The likelihood of large crown wildfires adversely affecting potential habitat by destroying understory and overstory vegetation would be reduced from 327,867 acres (59 percent) of all ponderosa pine to 129,762 acres (23 percent). Fire hazard index in grasslands would also be greatly reduced, from 5,000 acres to 138 acres). As a result, overland flow would be stable, and soil erosion would not have the high sediment loading potential. Water quality would not be adversely affected on a wide scale, resulting in indirect beneficial effects.

Under Alternative 2, spring and riparian restoration is proposed only in unoccupied habitat or with consultation with USFW. An important consideration for restoration of springs is to restore discharge from the spring source except where prescribed by existing adjudicated water rights. Alternative 2 would allow discharge from springs to resume flow through their historic spheres of discharge. Restoration implementation would increase riparian vegetation increasing availability of food and reproductive sites for this species over the long term, resulting in direct beneficial effects on habitat. Restoration would improve cover and water flow that provides escape from predators and prevents water loss for migrating leopard frogs.

Decommissioning unauthorized roads in RU 5 would improve the quality of the habitat in those areas where the roads are decommissioned. While the physical structure and features of the habitat may not measurably change along the former road alignment, eliminating disturbance along the roadway would be expected to improve the quality of habitat and reduce the potential for frogs to be crushed by vehicles using these roads. With each mile of road affecting approximately three acres of habitat, many acres of forested habitat may be improved within Chiricahua leopard frog breeding and dispersal habitat. Long-term effects would include habitat improvements over current conditions.

Constructing temporary roads would disturb vegetation and reduce habitat quality for leopard frogs. These effects may affect individuals but are expected to be short term, occurring only during project implementation. Temporary roads would be decommissioned to eliminate use and vegetation would be restored over the long term.

Implementation of the proposed action could increase the risk of spread of chytrid fungus across the project area. Machinery and equipment used during implementation could transfer chytrid fungus between waterbodies, increasing the occurrence of the pathogen in leopard frog habitats across the project area. Potential effects from chytrid fungus that is spread by machinery and equipment would be minimized by requiring decontamination procedures to be followed when activities take place within wetted areas or the moist perimeter of a tank or ephemeral stream and then immediately moving to another wetted area (see design features in Appendix C). Therefore, minimal potential for spread would exist.

Under the proposed action, surface disturbance within proximity of suitable habitats would increase. The use of heavy machinery and increased levels of human activity and traffic are likely to increase sedimentation in the earthen livestock tanks in the vicinity, especially in those located downslope from treatment areas. Effects from sedimentation on leopard frog habitats are extensive and varied. They include alterations in water quality and vegetation structure that ultimately have detrimental effects on leopard frogs by decreasing rate of development, increasing vulnerability to predators, and reducing food availability.

Additional meadow and grassland treatments are scattered throughout the project area and would occur in most of the area, increasing the likelihood that frogs would successfully forage around and migrate between available habitats due to decreased risk of predation.

Prescribed burning direct impacts are not likely, as most often, short term indirect impacts could occur due to sedimentation and increased ash flow. Prescribed burns where the majority of critical breeding sites occur would be coordinated with a wildlife biologist to insure protections for migrating frogs. In coordination with AZGFD, occupied, critical breeding, and potential breeding sites have been identified and mapped and would be included in the individual task order map with a protected water designation. Project design features (see below and Appendix 5 of the Wildlife Specialist Report) have been developed to reduce the potential effects on these important breeding sites and frogs using and moving between these sites. Implementation of best management practices would curtail soil erosion and minimize the potential for inflow into potential Chiricahua leopard frog habitat.

Critical Habitat

Effects on the primary constituent elements (PCE) of critical habitat are similar to the effects on suitable Chiricahua leopard frog habitat as described above. No long-term changes are expected to occur to any primary element from implementing the proposed action. Short-term effects on primary elements are possible related to water quality if precipitation follows directly after a burn, but these effects would be temporary and characteristics would return to pre-burn conditions. The proposed action would not significantly alter any of the characteristics of critical habitat primary constituent elements for the Chiricahua leopard frog.

PCE 1 – Aquatic breeding habitat and immediately adjacent uplands: Thinning and prescribed fire would not remove or reduce standing bodies of water within the action area. In the unlikely event that water is needed for fire abatement, it would not be drawn from any suitable or designated critical habitat but instead taken from an external source. Treatments under controlled conditions would reduce future sedimentation potential. Temporary roads needed to access areas for thinning would follow design features to mitigate soil and watershed damage. Prescribed fire would be managed to ensure lower-severity fire behavior, allowing for fuel reduction without soil damage. These actions would reduce the potential for sedimentation, ash accumulation, and the influx of pollutants that may degrade the water quality of important aquatic sites. It is unlikely for emergent or aquatic vegetation to be completely removed by back-burning fire because of moisture levels in riparian plants, burning techniques (back-burning), and the time in which prescribed burning would take place around frog populations. Some upland vegetation could be removed but this disturbance is expected to be short term and rebound during the following growing season.

Any effects that may occur as a result of the proposed action are anticipated to be insignificant given design features to reduce effects from implementation have been added to the proposed action (see Appendix C). These measures are in place to ensure that the proposed action would not contribute to the spread of nonnative predators and chytridiomycosis.

PCE 2 – Dispersal and nonbreeding habitat: Thinning and prescribed fire would only occur in riparian areas or near important aquatic habitat with consultation with a wildlife biologist. The proposed action would have no effect on CLF movement. Most structural features within dispersal habitat would be maintained (boulders, rocks, large downed logs, small mammal burrows); however, short-term effects on organic debris and leaf litter would occur. Overall, thinning, prescribed fire, and aquatic restoration implementation would have long-term beneficial effects by restoring habitat and protecting designated critical habitat from stand-replacing wildfires.

Cumulative Effects

The area analyzed for cumulative effects for Chiricahua leopard frogs is RU 5 within the Rim Country project area and a 0.25-mile buffer outside of the project boundary along RU 5 to include current and potential breeding sites. The temporal boundary is 25 years, to allow for 20 years of treatment plus an additional 5 years where effects would be ongoing. Restoration of aquatic habitats facilitated by this alternative would slow the combined cumulative effects from other forest activities, high-impact recreational use, livestock grazing, and habitat loss and degradation on private lands. Restoration implementation of key aquatic and dispersal habitat would cumulatively link, rather than fragment, these habitats allowing for the needs of breeding and dispersing leopard frogs.

Determination of Effect

Implementation of Alternative 2 may **affect** and is likely to adversely affect the Chiricahua leopard frog and designated critical habitat.

Alternative 3 – Focused Alternative

Direct and Indirect Effects

Direct and indirect effects from Alternative 3 would be similar to Alternative 2. Alternative 3 includes the same miles and acres of riparian restoration, while reducing the total number of acres thinned and treated with prescribed burning. Potential effects from chytrid fungus that is spread by machinery and equipment would be minimized by requiring decontamination procedures to be followed when activities take place within wetted areas or the moist perimeter of a tank or ephemeral stream. Therefore, minimal potential for spread would exist.

Alternative 3 treats fewer forested acres in Rim Country. Project design features have been developed (see Appendix C) to reduce the potential of effects on important breeding sites and the frogs using and moving between these sites.

Critical Habitat
Same as Alternative 2.

Cumulative Effects

Same as Alternative 2.

Determination of Effect

Implementation of Alternative 3 may **affect** and is likely to adversely affect the Chiricahua leopard frog and designated critical habitat**.**

Mexican Spotted Owl (Threatened)

Alternative 1 – No Action

This alternative proposes no restoration treatments, but habitat variables are modeled the same as for Alternatives 2 and 3 (Table 67, Table 68, Table 69). See Alternatives 2 and 3 Habitat Restoration in MSO Habitat below.

The no action alternative includes no new mechanical treatments or prescribed fire in Rim Country in any habitat, including ponderosa pine, pine-oak, aspen, meadows, springs, riparian areas, and streams. No road construction, maintenance, or decommissioning would occur within the project area. None of the associated wildlife habitats would be restored or moved toward restoration.

Alternative 1 Protected Habitat

Forest Structure

Under Alternative 1, large trees in PACs would not be replaced due to the stagnant growth rates. FVS modeling in PACs for Alternative 1 shows trees per acre would only slightly decrease, from the existing 1,291 MC and 1,276 P-O to 1,170 MC and 1,130 P-O in 2029 and 1,057 MC and 990 P-O in 2039. Quadratic mean diameter would only increase by one inch over 20 years (from six to seven inches), indicating a system that would not be growing large trees greater than 12 inches in diameter. The average of all basal areas, from the sapling Size Class 1 to old growth Size Class 6 shows that intermediate-sized trees (Size Class 3 with a basal area of 5 to12 inches and Size Class 4 with a basal area of 12 to 18 inches) would be predominant on the landscape and vastly departed from the natural range of variation and would not be lowered to the desired condition, a result of no treatments through 2039.

Snags

With no action, PACs would show an increase in coarse woody debris and snags greater than 12 inches in diameter (Table 68**Error! Reference source not found.**). While creation of large snags would continue, the decreasing numbers of large trees through time would maintain a deficit of large snags beyond the year 2039. Pulses of large snag creation may occur at any time as a result of fire, insects, and disease. Increases in large snags as an outcome of stochastic events would result in decreases of large trees.

Coarse Woody Debris and Understory

Small mammal habitat would be maintained through time in terms of logs and coarse woody debris (cover for prey species) under this alternative. However, accumulated coarse woody debris could decrease MSO habitat effectiveness (Roberts et al. 2010). Herbaceous biomass in tons per acre (food for prey species) and shrub biomass in tons per acre (cover for prey species) would not change in both the short term and long term under Alternative 1 (Table 68). However, canopy development combined with a lack of fire and increased needle accumulation would cause a continued decline in understory through time. The continued loss and fragmentation of understory vegetation would limit invertebrate populations, including pollinators. If this pattern continued over time, a cascading effect could occur as arthropod species richness and abundance declines, increasing the rate of decline in understory biomass and potentially causing an additive effect to MSO prey species. Combined decreases in understory vegetation and associated arthropod communities could affect MSO directly (lack of flying insects as prey) and indirectly (food availability for prey species such as mice, voles, birds, and bats). Understory vegetation would remain at low levels of productivity and would continue to decrease through time, except in areas where fire, insect, or disease opened the canopy.

Fire Effects

Maintaining the current trajectory for forest conditions would maintain the increasing risk of uncharacteristic fire. Ponderosa pine ecosystems would become increasingly departed from desired conditions under Alternative 1, increasing risks to ecosystem structure, pattern, composition, and function. Fire hazard index and risk of crown fire (modeling shown in the existing condition section) are greatly increased in the No Action Alternative compared to the action alternatives.

Surface fuel loading in protected habitat, including litter, duff, and coarse woody debris greater than three inches, would be high under Alternative 1, moving from an existing condition of 18.7 tons per acre to 27.04 tons per acre in 2049. Fire Hazard Index Modeled in MSO Habitat Types). Crown fire would be more likely if surface fuel build-up continues, leading to increased flame lengths. High surface fuel loadings can negatively affect MSO prey populations by altering the understory vegetation response, negatively affecting food resources for prey species.

Fire Hazard Index high and extreme need for treatment categories are increased under Alternative 1 from 49,889 acres (41 percent of the PACs in the project area in need of treatment) in existing condition to 57,191 acres (47 percent) of all PACs in the project area are expected to experience high-severity wildfire. In Recovery Nest/Roost habitat 4,175 acres (41 percent) of Nest/Roost Recovery habitat in the project area) with high and extreme need for treatment in the existing condition goes to 4,991 acres (49 percent) in Alternative 1. Foraging/Non-breeding Recovery habitat goes from 10,717 acres (26 percent) with high and extreme need for treatment in the existing condition to 14,337 acres (34 percent) in Alternative 1 (see Table 61 and Table 62).

Table 61. Fire Hazard Index modeled in MSO habitat types for the Existing Condition

MSO Habitat Type	Very Low Need For Treatment in Acres	%	Moderate Need for Treatment in Acres	%	Low Need for Treatment in Acres	%	High Need for Treatment in Acres	%	Extreme Need for Treatment in Acres	%
Protected PAC 120,970 Acres Modeled	29,277	24	19,049	16	22,761	19	32,865	27	17,024	14
Recovery Nest/Roost 10,288 Acres Modeled	2,678	26	2,054	20	1,381	13	2,112	21	2,063	20
Recovery Foraging/Non-Breeding 41,879 Acres Modeled	16,931	41	7,828	19	6,402	15	7,237	17	3,480	08

Table 62. Fire Hazard Index modeled in MSO habitat types for Alternative 1

MSO Habitat Type	Very Low Need For Treatment in Acres	%	Moderate Need for Treatment in Acres	%	Low Need for Treatment in Acres	%	High Need for Treatment in Acres	%	Extreme Need for Treatment in Acres	%
Protected PAC 120,970 Acres Modeled	22,027	18	16,920	14	24,830	21	35,358	29	21,833	18
Recovery Nest/Roost 10,288 Acres Modeled	1,522	15	1,598	15	2,175	21	2,643	26	2,348	23
Recovery Foraging/Non-Breeding 41,879 Acres Modeled	10,966	26	5,483	13	11,093	27	10,378	25	3,959	9

The potential for active and conditional crown fire would be increased in the No Action Alternative compared to the existing condition, from 58,243 acres (48 percent of the PACs in the project area) to 61,606 acres (51 percent) that would experience high-severity crown fire in Alternative 1. Both types of recovery habitat would also have increased risk of crown fire from the existing condition with Alternative 1 (Table 63).

Table 63. Potential for Crown Fire Modeled in MSO Habitat Types for Alternative 1

MSO Habitat Type	Active Crown Fire Acres	%	Conditional Crown Fire Acres	%	Passive Crown Fire Acres	%	Surface Fire Acres	%
Protected PAC	42,151	52	1,404	2	26,744	34	11,396	14
Recovery Nest/Roost	5,414	53	92	1	3,712	36	1,078	10
Recovery Foraging-Non-Breeding	18,102	43	358	1	19,130	46	4,262	10

Maintaining current forest conditions would maintain a high fire hazard index (83 percent at risk of stand-replacing fire conditions and increased risk of crown fire). Over 73 percent of MSO PACs would likely burn with crown fire under Alternative 1. The likelihood of high-severity fire and the size of wildfires producing undesirable effects would continue to increase. Alternative 1 would not follow Recovery Plan guidance for retaining management flexibility for abating the risk of high-severity fire in PACs (USDI FWS 2012b).

Alternative 1 does not meet the purpose and need for the Rim Country Project. Forest structure and health in MSO habitat would continue to degrade over time. Development of the large tree component would continue to be compromised by density-dependent competition and mortality. Understory development would be maintained at uncharacteristically low levels and continue to decline. Other specialty habitats important to prey species such as riparian areas, meadows, aspen, springs, and stream channels would continue to degrade or be lost entirely over the long term. MSO habitats would be on a trajectory moving away from desired conditions as described in the Coconino, Tonto and Apache-Sitgreaves Forest Plans.

Alternative 1 Nest/Roost Recovery Habitat

Forest Structure

Under Alternative 1, No Action, FVS modeling (see Alternatives 2 and 3 Habitat Restoration in MSO Habitat below.

In MSO Nest/Roost Recovery Habitat shows that over time trees per acre are reduced, but not to within the natural range of variation. Trees per acre in the existing condition (1,100 mixed conifer, 1,280 pine-oak, and 1,351 modeled recovery habitat on the Tonto) would change to 873 mixed conifer, 1,052 pine-oak and 1,134 modeled recovery habitat on the Tonto in 2039). Stand density index would remain high, from 420 mixed conifer, 369 pine-oak, and 441 modeled recovery habitat on the Tonto in the existing condition, to 438 mixed conifer, 380 pine-oak, and 445 modeled recovery habitat in 2039. The quadratic mean diameter would only increase two inches in mixed conifer and one inch in pine-oak over 20 years. The FVS Modeled Effects on Key Habitat Variables in Recovery Nest/Roost Habitat from No Action Alternative can be seen in table 13 in the section on effects mechanical thinning and prescribed burning for alternatives 2 and 3.

Snags

Snags greater than 12 inches in diameter show no change in any cover type under Alternative 1 (table 13). While creation of large snags would be maintained, the decreasing numbers of large trees through time could maintain a deficit of large snags beyond the year 2039.

Coarse Woody Debris and Understory

Downed logs and course woody debris (cover for prey species) would increase over time as a result of no action. Herbaceous biomass in tons per acre (food for prey species) would not change under Alternative 1 over the 20 years modeled (0.21 tons per acre existing condition in mixed conifer and pine-oak cover types, and 0.20 in modeled recovery habitat acres on the Tonto, is maintained through 2039). Shrub biomass in tons per acre (cover for prey species) would decrease in mixed conifer and would be maintained in pine-oak under Alternative 1, moving from 0.4 tons per acre in mixed conifer to 0.3 tons per acre in 2039 (Table 68).

Fire Effects

Surface fuel loading in MSO Nest/Roost Recovery habitat, including litter, duff, and coarse woody debris greater than three inches, would be high under Alternative 1, moving from an existing condition of 30 tons per acre in mixed conifer, 19 in pine-oak to 37 tons per acre in mixed conifer, 26 in pine-oak in 2039 (Table 68).

Fire Hazard Index would be increased from 8,035 acres (78 percent of the Nest/Roost Recovery habitat in the project area in need of treatment) to 9,150 acres (89 percent). The highest and greatest hazard categories of Fire Hazard Index in Nest/Roost Recovery habitat total 5,594 acres (50 percent) of all Nest/Roost Recovery habitat in the project area and are expected to experience high-severity wildfire.

Potential for crown fire is expected to increase in the No Action Alternative, from 8,290 acres (81 percent) to 9,218 acres (90 percent). Active crown fire in Nest/Roost Recovery habitat totals 5,414 acres (53 percent) of this habitat type in the project area that would experience high-severity crown fire.

Alternative 1 Foraging/Non-Breeding Recovery Habitat

Forest Structure

Under Alternative 1, No Action, FVS modeling shows that trees per acre in Foraging/Non-Breeding MSO Recovery Habitat would be reduced, but not to within the natural range of variability (from 1,398 in mixed conifer, 1,192 in pine-oak, and 1,443 modeled recovery habitat on the Tonto National Forest, to

1,101 in mixed conifer, 952 in pine-oak, and 1,196 modeled recovery habitat on the Tonto National Forest in 2039). Stand density index would remain high, from 376 in mixed conifer, 329 in pine-oak, and 407 modeled recovery habitat on the Tonto National Forest, to 182 in mixed conifer, 158 in pine-oak, and182 modeled recovery habitat on the Tonto National Forest in 2039. The quadratic mean diameter would only increase by one inch over 20 years.

Snags

Foraging/Non-Breeding Recovery Habitat under Alternative 1 would have an increase in coarse woody debris and snags greater than 12 inches in diameter (see Table 69). While creation of large snags would continue, the decreasing numbers of large trees through time could maintain a deficit of large snags beyond the year 2039.

Coarse Woody Debris and Understory

Downed logs and coarse woody debris (cover for prey species) would increase over time as a result of no action. Herbaceous biomass in tons per acre (food for prey species) would not change under Alternative 1 over the 20 years modeled (0.21 tons per acre in mixed conifer and pine-oak maintained through 2039). Shrub biomass in tons per acre (cover for prey species) would show little change in both the short term and long term under Alternative 1, moving from an average 0.25 tons per acre to 0.28 tons per acre in 2039.

Fire Effects

Surface fuel loading in MSO Foraging/Non-Breeding Recovery Habitat, including litter, duff, and coarse woody debris greater than three inches, would be high under Alternative 1, moving from an existing as high as 24 tons per acre to 32 tons per acre in 2049.

Fire Hazard Index is expected to increase from 10,717 acres (26 percent of the Foraging-Other Recovery habitat modeled as in need of treatment) to 14,337 acres (34 percent). The potential for crown fire would be increased with no action, from 15,090 acres (36 percent) to 16,302 acres (39 percent).

Other Habitat Effects

Springs, Riparian and Stream Habitat, Grasslands, Savannas, Meadows, and Aspen. No springs or riparian habitat would be restored. One hundred eighty-four (184) springs and associated prey habitat would remain in degraded condition within the project area, with many included in PACs. Similarly, wildlife habitat associated with almost 171 miles of riparian stream channels would remain in degraded condition within MSO habitat. The grasses, forbs, and shrubs that could potentially occupy these sites would remain absent or limited in both species richness and abundance.

No grassland, savanna, or meadow treatments would occur, resulting in nearly 350 acres in PACs and over 60,390 acres of this important habitat continuing to degrade as a result of pine tree encroachment in MSO habitat. This would represent a decline in the quantity and quality of habitat for grassland associated species, including obligate migratory and sensitive avian species. As food and cover decline for small mammals, potential source populations of important MSO prey species would be expected to decline in the long term. Overall, the landscape would move toward homogeneity as ponderosa pine continued to compromise or eliminate these key sources of heterogeneity.

Unique wildlife habitat features associated with 1,230 acres of aspen would decline or vanish as losses continued. Conifer trees would gradually succeed aspen trees through competition for space, light, and water, which is a major cause of aspen decline (Johnson 2010). Associated declines in regional avifauna would occur as a result of habitat loss (Griffis-Kyle and Beier 2003). The rate of avian decline could increase as habitat changes favored nest predators (Johnson 2010). Understory biomass, which provides the food and cover to support MSO prey species (for example, small mammals, birds, and arthropods), would decrease exponentially as conifer cover increased (Stam et al. 2008).

The effects of these microhabitats are greater than their combined total acres. This is particularly relevant when these patches of heterogeneity occur in PACs where MSOs disproportionately forage during the nesting season.

Roads. Under the no action alternative, no new restoration activities would take place and no additional use of existing roads would occur. Current rates of public and administrative use would continue. Maintenance to provide public and administrative access would continue, contingent upon funding. No increase in road maintenance to accommodate restoration activities would occur. No temporary roads would be constructed, but also no road decommissioning, unless they are analyzed under separate NEPA analysis.

Alternative 1 Direct and Indirect Effects

With no treatments occurring, there would be no direct increase or decrease in habitat quality of MSO protected, recovery, or critical habitat in the short term. In the long term, MSO habitat quality would decrease as a result of declines in forest health and resiliency.

The lack of mechanical thinning and low-severity prescribed fire would allow the current forest trajectory to continue. Dense forests would maintain closed canopy conditions but continue to exhibit reduced growth rates. The abundance of young and mid-aged forest would continue to dominate the landscape because of stagnating growth rates and competition-induced mortality of large trees. Gambel oak, aspen, and meadows would decline as pine encroachment continued. Spring function would decline as would reaches of riparian habitat channels. Competition for limited water and nutrients would continue and would increase in time as snow pack decreased with developing climate change.

This alternative would not reduce the threat of high-severity fire, which is a primary concern for the recovery of this species. Surface fuels would continue to increase and understory vegetation decrease or remain the same. Alternative 1 would not contribute to improving forest health or vegetation diversity and composition, sustaining old forest structure over time, or moving forest structure toward the desired conditions.

No additional disturbance from noise, smoke, or other aspects of implementation activities would occur under this alternative.

Cumulative Effects

Because of the size of the 4FRI Rim Country project area and the large portion of the western Upper Gila Mountain Recovery Unit and a portion of the Basin and Range Recovery Unit that it occupies, the project area itself was considered adequate for assessing habitat effects on PACs. Due to the potential for disturbance to owls, the cumulative effects analysis boundary was extended 0.5 mile beyond the project area periphery to account for the spatial component of this analysis. Cumulative effects include the effects of Alternative 1. With this additional 0.5-mile buffer, there are 209 PACs in the cumulative effects analysis area Table 64. The temporal component in this analysis was defined as 10 years for short-term effects and 30 years for long-term effects.

Table 64. MSO PACs Within or in Close Proximity to the Rim Country Project Area

PAC Location	Number of MSO PACs
Within Areas of Proposed Mechanical and Fire Treatments[1]	156
Within the Rim Country Project Area[2]	196
Within 0.5 mile of the Project Area Boundary	209

1. The area where treatments are proposed in the Rim Country project area, a subset of the total project area.
2. Total area including all vegetation cover-types and all projects managed by the Forest Service within the 4FRI boundary

The effects from projects before 2000 are incorporated into existing conditions. Aspects of existing conditions that are a result of these early projects include a deficit in large trees and snags and even-aged conditions. Pre-2000 projects also had heavy selection pressure for preferred tree genetics to provide healthy trees with good form. This latter effect resulted from harvested areas being regenerated from planting stock or from the selected reserve trees left in seed tree harvest units (Higgins, personal communications 2006). Wildlife habitat in the form of nesting, feeding, and loafing sites was reduced by selecting for disease-free trees with symmetric shapes, eliminating fork-top trees, trees with unusual branching patterns, and replanting with selected genetic stock from nurseries.

Cumulative Effects Alternative 1 – No Action

Alternative 1 would not contribute to the improvement of either forest structure or prey habitat within MSO habitat. The contributions of past, ongoing, and reasonably foreseeable actions would affect habitat for MSO and their prey, but no cumulative effects would result from 4FRI Rim Country (such as, no change would occur either spatially and temporally to alter these effects of other actions on the landscape).

Maintaining existing conditions would extend the current deficit of trees greater than 24 inches in diameter. Current numbers of trees per acre greater than or equal to 18 inches in diameter, already below forest plan and Recovery Plan direction, would likely be maintained due to increases in mortality rates resulting from competition. Slow to stagnating tree growth rates would prolong the time required for mid-aged trees to grow into mature trees. Replacement of mid-aged trees by younger trees would occur at low rates because of current deficits in small size classes, delaying, limiting, or preventing the long-term attainment of desired conditions for mature and old-growth forest. Ponderosa pine is not a shade-adapted species. Therefore, consistently dense canopy cover would delay or prevent development of multi-storied and uneven-aged forest structure in the long term. Growth could be further suppressed and mortality rates increased if climate patterns continue toward hotter and drier growing conditions. Within-stand mortality resulting from competition for rooting space, water, and nutrient availability, vulnerability to insects and disease, and fire could lead to patches of more open conditions. This could reduce potential nesting and roosting habitat even in locations where individual trees might benefit and eventually grow into larger size classes.

Pine-oak habitat would remain outside the natural range of variation in terms of tree densities and age-class distribution under Alternative 1. Loss of large diameter oak would continue, as would the suppression of young oak by competing pine trees. Total basal area in oak may decline over time and would likely remain below desired conditions. Dense forest structure could increase the risk of insect and disease outbreaks occurring and increase the scale at which they occur. Stochastic events outside the natural range of variation could continue to slow or prevent development of new MSO nesting and roosting habitat.

Limited road closures would allow continued access to most of the existing roads footprint and would maintain the same threat to large snag persistence. Ecosystem function would continue to decline with continued tree encroachment into spring, channel, meadow, and aspen habitats.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the risk of high-severity fire through time. By not treating outside of MSO habitat, the risk of high-severity fire remains high from ignitions starting outside of pine-oak habitats as well as fire igniting within MSO habitat.

Determination of Effect

Based on the above analysis, Alternative 1 of the 4FRI Rim Country Project **may affect, is likely to adversely affect the Mexican spotted-owl.**

Effects Common to Both Action Alternatives

Environmental consequences are described by MSO habitat type (for example, protected and recovery) and designated critical habitat. Proposed treatments are similar across MSO habitat types, although the degree to which they are implemented would vary depending on specific stand conditions. Modeled results are based on stand-specific outputs and represent the variability in treatment implementation. The objectives of the treatments are to increase tree growth rates, retain large pine and oak trees, and increase forest resiliency. Recovery nest/roost habitat would be managed to maintain or achieve nest/roost conditions sooner than if they were not treated. Forest conditions in nest/roost habitat would remain at or above nest/roost values after treatments as shown in Table C.3 of the Recovery Plan.

The objective of the Rim Country treatments in MSO habitat is to improve forest structure for owls as defined in the Recovery Plan per the Flexible Toolbox Approach for Mechanical Treatments (Appendix 2). This is different from an emphasis on fuels reduction. Large trees would be retained, and targeting mid-aged trees would improve the health, growth rates, and sustainability of large trees. Certain habitat and stand structures warrant additional consideration. For example, some MSO habitat and certain stand conditions require consideration of additional management constraints before prescribing treatments. PACs exhibit a variety of topographic and forest conditions and occupied PACs can already be considered successful nesting habitat. Mechanical treatments in PACs would be designed to maintain or improve the characteristics that make each PAC effective at providing habitat while also making them resilient to disturbance. Consideration should be given to:

- increasing the number of large trees
- creating additional foraging habitat for MSO
- the fire hazard index in the PAC and whether it is in wildland-urban interface (WUI)
- restoration and protection of other resource values nearby, such as perennial water
- protecting other values at risk

Treating areas near PACs should be considered in order to improve resiliency in the PACs themselves. PACs should be treated with consideration of the larger landscape and not just separate entities. Specific treatments in PACs would be determined prior to implementation and in consultation with U.S. Fish and Wildlife Service (FWS) personnel. In nest/roost recovery habitat, the Flexible Toolbox Approach for Mechanical Treatments (Appendix D) states that, though recovery nest/roost habitat is distinct from PACs, their management objectives are similar. Any treatment proposed in MSO nest/roost recovery habitat should be designed specifically to maintain or accelerate the trajectory of these stands towards desired habitat conditions in the foreseeable future. Achieving management objectives within MSO foraging or other recovery habitat can be addressed with the flexible toolbox approach. Stands in recovery habitat would be assigned a treatment using the decision matrices; however, additional management direction would be applied such as maintaining increased basal area (40-110 BA for pine-oak and 40-135 BA for mixed conifer). This additional guidance is included in the project design features to ensure resource protection (see Appendix C).

Alternatives 2 and 3 Habitat Restoration in MSO Habitat

A total of 196 PACs (110,890 acres) occur in the Rim Country project area. An additional 39,748 acres either fall outside of the Rim Country boundary area (11,269 acres) or occur in other project areas (28,479 acres). These 39,748 acres would be treated as those projects planned and consulted with FWS. Twenty-nine PACs would have some other type of restoration (riparian, wet meadow, grassland, aspen, etc. see Actions common to Alternatives 2 and 3 below). In the 4FRI Rim Country project area, up to 82,411 acres of protected MSO habitat are proposed for thinning and/or burning, or other habitat restoration with Alternatives 2 and 3. Various restoration activities could occur under Alternatives 2 and 3 in MSO habitat. These activities include grassland and meadow restoration, spring restoration, riparian stream and stream channel restoration, stream habitat restoration, and aspen restoration. Acres and miles for other restoration activities were calculated for PACs (Table 65). Recommended design features to minimize effects on wildlife for all restoration activities proposed in PACs were reviewed and would not result in additional effects that are not already disclosed (Appendix 5). These activities would be implemented in recovery habitat types under both Alternatives 2 and 3: however, design features intended to improve stand and habitat quality would also be applied to achieve restoration success (see Appendix C). The restoration of these habitat types within recovery habitat would contribute to the mosaic treatment effect desired in the MSO Recovery and Forest Plans.

Table 65. Acres of restoration treatments proposed in MSO PACs

Treatment	PAC Acres
Mechanical Vegetation Treatments Total	24,873
Aspen Restoration	28
Facilitative Operations	298
PAC – Mechanical	18,371
Severe Disturbance Area Treatments	3,609
Grasslands Restoration	72
Riparian Restoration	2,142
Riparian/Wet Meadow Restoration (Overlap)	98
Wet Meadow Restoration	256
Prescribed Fire Total	82,411
Prescribed Fire Only	49,066
Facilitative Operations Prescribed Fire Only	7,875
Mechanical and Prescribed Fire Treatment	24,873
Riparian Restoration within Core Areas	610
Riparian/Wet Meadow Restoration (Overlap) within Core Areas	31
Wet Meadow Restoration within Core Areas	33
Stream Restoration (in miles)	171*

*Note that the stream restoration is measured in miles.

Aspen Restoration

All aspen restoration activities in PACs would happen outside of the breeding season. Recommended design features for aspen restoration are included so that aspen restoration activities would not result in additional effects that are not already disclosed. Currently, one PAC on the Coconino National Forest was identified for aspen restoration treatment (28 acres), the Schell Spring PAC.

Facilitative Operations

Facilitative operations may be needed in non-target cover types (such as pinyon-juniper) to support treatments in target cover types (ponderosa pine types). Within four PACs, approximately 300 acres could receive mechanical facilitative operations. Within 71 PACs, about 7,880 acres could be treated using prescribed fire facilitative operations. Design features have been added to mitigate disturbance to MSO from these activities.

Severe Disturbance Areas

Restoration treatments in severe disturbance areas would include combinations of reforestation, prescribed fire, lopping/scattering, mastication, and other mechanical methods, with the objective of identifying treatments that would be effective in restoring the fuel structure that produces the types of fire to which ponderosa pine is adapted. Thirty-three PACs (about 10,070 acres) could have severe disturbance restoration activities associated with them. Twelve PACs would have grassland restoration activities on approximately 72 acres. Twenty-seven PACs would have wet meadow restoration on approximately 420 acres. Design features (see Appendix 5, Appendix C) have been included to mitigate disturbances to MSO from these activities.

Grassland and Wet Meadow Restoration

Twelve PACs would have grassland restoration activities on approximately 72 acres. Twenty-seven PACs would have wet meadow restoration on approximately 420 acres. Design features (see Appendix 5, Appendix C) have been included to mitigate disturbances to MSO from these activities.

Stream and Riparian Restoration

A total of nearly 171 miles of stream restoration, with approximately 2,880 acres of riparian restoration, could occur in 127 PACs in the Rim Country project area. All restoration activities in PACs would happen outside of the breeding season. Spring and riparian stream channel and habitat restoration would also occur in MSO recovery habitat across the project area. See the Flexible Toolbox Approach for Aquatic and Watershed Restoration Activities for a complete description of restoration activities proposed (Appendix 3). Design features have been included to minimize effects on MSO, to promote primary constituent elements in MSO habitat, and to avoid disturbance to MSO from implementation.

Skid Trails, Excaline, and or Tracked Harvesters

Skid trails could be needed in PACs and recovery habitats in order to accomplish thinning treatments; however, all would be rehabilitated after harvesting. Ground disturbance from skid trails can cause indirect effects from the loss of vegetation through compaction and rutting and exposure of bare mineral soil. Harvest activities with skid trails could adversely affect the prey base on a short-term basis by affecting individuals of prey species due to disturbance of prey species' habitat. As analyzed by the Rim Country soil scientist,

"Mechanical thinning of the ponderosa pine forests of Arizona has been occurring since the 1980s mainly through whole tree harvesting on slopes less than 40 percent. Typical equipment used for such harvesting includes rubber-tired feller bunchers and rubber-tired skidders with tracked dozers used for piling of slash. The amount of disturbance as a percentage of a typical harvest unit (such as, area included in a thinning contract) affected by compaction, rutting, and/or exposure of bare mineral soil from this type of harvesting has been estimated to be roughly 15 percent associated with feller-buncher and skidding operations, three percent associated with machine piling of slash, three percent associated with landings, and three percent associated with temporary roads (MacDonald 2013).”

Design features have been incorporated to minimize disturbance from heavy machinery operations, and thus would generally minimize compaction, rutting, and/or exposure of bare mineral soil in these areas.

Of the 24,873 acres of ground-based harvest methods in MSO PAC habitat, 5,223 acres (21 percent) could be affected by compaction, rutting, and/or exposure of bare mineral soil from mechanical thinning operations. No temporary roads are needed if skid trail lengths are increased as described in the roads section below, adding an additional 10 acres. This represents four percent of the total PAC acres (122,158 acres) in the 4FRI Rim Country project area. Effects are short term, dispersed across the landscape, with rehabilitation efforts incorporated through best management practices to reduce effects to MSO habitat.

Roads

Alternative 2 and 3 are the same in terms of roads proposed to haul material. The main difference is that in Alternative 3 temporary roads would be reduced from 330 to 170 miles. It is assumed that nearly all, if not all system roads within the project area could be utilized at some point in time to carry out restoration activities.

Road Maintenance- Roads that would be utilized for restoration work and hauling of forest products would likely see pre-haul maintenance if needed to make the roads passable to truck traffic, as well as maintenance during hauling and post haul maintenance. This maintenance would be in additional to a forest’s regular schedule of maintenance.

Road Decommissioning- Under this alternative up to 200 miles of system road on the Coconino and Apache-Sitgreaves National Forests could be decommissioned. The Tonto National Forest Travel Management EIS has identified approximately 290 miles of road within the Rim Country project area for decommissioning. In addition to system road decommissioning, up to 800 miles of unauthorized roads on all three forests may be decommissioned under this alternative.

Temporary Roads - Under Alternative 2 up to 330 miles of temporary road could be utilized to facilitate harvest activities. Under Alternative 3 up to 170 miles of temporary road could be utilized to facilitate harvest activities. These temporary roads may be new construction or also utilize existing unauthorized roads. Temporary roads would be decommissioned when harvesting and related restoration work is completed in the area that they access.

On June 11 2018, the Forest Operation Specialist met with the 4FRI Wildlife Biologist and GIS Specialist to conduct analysis of the need for temporary roads to mechanically treat proposed acres in PACs. Of the 150 PACs in the 4FRI Rim Country project area, 111 of these have areas greater than 1,250 feet from an existing road. Twenty (20) of these (see wildlife specialist report) have greater than 20 acres of habitat proposed for thinning. It was determined that, due to topography, ecological concerns (for the MSO, soils, and hydrology), and a small number of acres receiving treatment, these limited treatments would merit increased skidding lengths instead of temporary road construction. Therefore it was determined that no new temporary roads would be created in PACs in the 4FRI Rim Country project area.

Increased skid trail lengths for these acres were calculated with the hydrologist’s recommendation to determine the acreage of these longer skid trails. These increased skid trail lengths would affect an additional 10 acres of MSO Protected habitat.

Smoke from Prescribed Fire

Smoke from broadcast and pile-burning could temporarily disturb MSOs. Pile burning occurs during the winter and would not be expected to have direct effects on nesting owls. Burning would be managed to minimize the accumulation of smoke in PACs during the breeding season. Short-term effects from smoke would be reduced by coordinating the timing and type of burning with wind direction, topography, time of year, and distance to PACs. Initial entry burning would not occur in nest cores during the breeding season and burning would be restricted during the breeding season in areas that may create smoke effects on occupied PACs. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignitions sites. Areas selected to protect PACs by thinning and burning outside of the PAC were developed in conjunction with the 4FRI Rim Country team and with the USFWS. With this information in mind, along with the concept that the species presumably adapted and evolved with smoke from wildland fire, smoke-related effects from maintenance burning would not be substantial.

The use of prescribed fire brings inherent uncertainty. While this would be minimized through the use of ignition and control techniques, the sheer number of acres and discrete applications of fire (such as, all or parts of 156 different PACs) increases the risk of fire burning out of prescription. While individual trees or pockets of torching could improve habitat conditions by adding diversity in dense, relatively homogeneous stands of pine-oak, the same action in other stands or larger areas of torching could create long-term adverse effects on MSO habitat. Adverse effects would only happen if burning exceeded prescription, therefore the degree of risk is unknown, unquantifiable, but remains a risk.

Smoke may have an adverse effect if predicted weather conditions change during burn operations. Smoke tends to settle into low-lying areas, including canyons which serve as owl habitat. Lung damage could occur if smoke settles into PACs with incubating adult or nestling MSOs for continuous days and nights. Lung damage could result from continuous exposure to high smoke levels. MSOs could be forced to alter foraging behavior as a result of extended smoke. Altered foraging behavior could leave owls vulnerable to predators. Under these circumstances, smoke settling into PACs could cause adverse effects. The risk of this is low due to the design features specifically developed to minimize this threat. However, some risk remains although it is considered low and is unquantifiable.

Wildfire

Fire hazard index and crown fire assessment was modeled for MSO and wildlife habitat types proposed for treatments. Fire modeling includes one treatment and two prescribed burns through the year 2029. After this period, maintenance burning is expected to maintain desired conditions across the project area or until further planning is needed. Fire hazard index and risk of crown fire was modeled for 120,975 acres in PACs, 10,288 acres in Nest/Roost recovery habitat, and 41,878 acres in foraging/non-breeding MSO recovery habitat. Table 66 shows the amount of each habitat type with risk ratings of Low, High, and Extreme by alternative. The existing condition shows that 49,889 acres, or 41 percent of all PACs within the project area, are at risk of high-severity wildfire. Alternative 2 reduces this risk to 29 percent of PACs, six percent of Nest/Roost recovery habitat, and one percent of Foraging/non-breeding habitat.

Table 66. Acres of MSO Habitat with High and Extreme Fire Risk by Alternative with Percentages of Total Habitat Modeled in the Project

Fire Hazard Index	Existing	Alternative 1	Alternative 2	Alternative 3
PAC	49,889 (41%)	57,191 (47%)	33,410 (28%)	33,105 (30%)
Nest/Roost Recovery	4,175 (41%)	4,992 (49%)	588 (06%)	778 (08%)
Foraging-other Recovery	10,717 (26%)	14,337 (34%)	372 (01%)	1,845 (04%)

The modeled potential for active and conditional crown fire (with percentages of each habitat type in the project area that could experience these categories of crown fire) is shown in Table 11 above. The action alternatives greatly reduce these risk categories of crown fire across MSO habitat types. For example the risk of active and conditional crown fire in PACs is reduced to 28 percent in Alternative 2 from 50 percent in Alternative 1. Risk of active and conditional crown fire in Nest/Roost recovery habitat is reduced to just 407 acres (four percent) in Alternative 2, from 16,032 acres (50 percent) in Alternative 1. The risk of crown fire in Foraging/Non-breeding recovery habitat is reduced to 350 acres (one percent) in Alternative 2.

Table 67. Active and Conditional Crown Fire Assessment Comparison of Alternatives in Wildlife Habitat (with Percentages of Total habitat Modeled in the Project Area)

MSO Habitat Type	Existing	Alternative 1	Alternative 2	Alternative 3
PAC	58,243 (48%)	61,608 (50%)	34,068 (28%)	33,044 (30%)
Nest/Roost Recovery	4,802 (47%)	5,183 (50%)	407 (04%)	685 (07%)
Foraging-other Recovery	15,090 (36%)	16,302 (39%)	350 (01%)	2,317 (06%)

Mechanical Thinning and Prescribed Burning

Alternatives 2 and 3 would follow forest plan direction, including implementing guidelines from the revised MSO Recovery Plan (USDI FWS 2012). Cover types may have all or some of the direction for MSO habitats, depending on location and stand structure. The objective of Rim Country treatments in MSO habitat is to improve forest structure for owls as defined in the Recovery Plan and in the Flexible Toolbox Approach for Mechanical Treatments (Appendix 2).

In MSO PACs: Potentially thin and burn to improve structure, maintain and develop large trees, and reduce risk of high-severity fire in PACs. No mechanical treatments, but fire may be implemented, in 100-acre core areas. Outside core areas, trees may be thinned and/or prescribed fire implemented where feasible to improve forest structure and minimize undesirable fire effects. Promote irregular tree spacing to create canopy gaps more conducive to treatment with prescribed fire, retain old growth attributes, protect large oaks, and ensure snags and coarse woody debris post-fire. Develop treatments in consultation with FWS.

In MSO Recovery Habitat: Follow Table C3 in revised MSO Recovery Plan for potential future nest/roost habitat and provide for owl daily movements, dispersal, and foraging habitat.

In MSO Recovery Habitat outside of potential future Nest/Roost: follow forest plan guidance. Intent is to continue to develop replacement Nest/Roost where possible, otherwise treat to develop a diverse mix of heterogeneous stand structures and densities to provide for owl dispersal and foraging. Design Features have been added to mitigate disturbance to the MSO from these activities (Appendix C).

Because of planning and timing restrictions, noise disturbance to owls is not expected in PAC habitat where the majority of foraging is done by nesting owls. Owls foraging outside PACs during nesting season could potentially be displaced by thinning activities and increased truck traffic. Owls could also be displaced by harvest activities and increased truck traffic outside the nesting season. Displaced owls could be more vulnerable to predation.

Vehicular traffic would not simultaneously increase across the entire implementation area, but harvest-related traffic increases would occur in localized areas somewhere on the landscape for every year of implementation. Most traffic is expected to occur during diurnal hours when MSO activity would be minimal. However, hauling of materials from harvest locations to highways could occur at night when owls are active. Once harvest activities are complete, traffic is expected to return to pre-harvest levels.

The amount of traffic increases the risk of collisions between owls and trucks. There have been documented instances of spotted owls being hit by vehicles on paved and unpaved roads. Although little information is available on the frequency or conditions related to the risk of collisions, the assumption is being made that, because of the scale of increase in truck traffic, the risk of collisions with owls would increase. The threat of collisions would be reduced below existing conditions in the long-term as a result of road decommissioning.

Treatments in MSO habitat were modeled using FVS (see Vegetation Report). Table 68 display the habitat variables important to the MSO and the modeled effects on them in protected habitat in 2019, 2029, and 2039.

MSO Protected Habitat

Table 68. FVS Modeled Effects on Key Habitat Variables in MSO Protected Habitat

PACs MC = 16,481 Acres Modeled PO = 56,180 Acres Modeled	Existing	No Action 2029	No Action 2039	Alt 2 2029	Alt 2 2039	Alt 3 2029	Alt 3 2039
Average of tpa MC	1291	1170	1057	392	227	531	379
Average of tpa PO	1276	1130	990	369	232	496	368
Average of BA MC	173	185	196	131	127	131	130
Average of BA PO	144	155	163	110	106	117	117
Average of SDI MC	398	414	425	253	218	262	235
Average of SDI PO	339	353	362	215	191	237	223
Average of QMD MC	6	6	7	9	12	9	12
Average of QMD PO	6	6	7	9	11	9	10
Average of SNAG 12-18” MC	4	3	3	8	5	7	5
Average of SNAG12-18” PO	2	3	3	5	5	5	4
Average of SNAG18-24” MC	2	1	1	3	2	2	2
Average of SNAG18-24” PO	1	1	1	1	1	1	1
Average of SNAG ≥ 24” MC	1	1	1	1	1	1	1
Average of SNAG ≥ 24” PO	0	0	0	1	1	1	1

PACs MC = 16,481 Acres Modeled PO = 56,180 Acres Modeled	Existing	No Action 2029	No Action 2039	Alt 2 2029	Alt 2 2039	Alt 3 2029	Alt 3 2039
Average of CANCOV-BA Regression MC	74	76	78	67	66	67	67
Average of CANCOV-BA Regression PO	69	71	73	62	61	64	64
Average of Surface Fuel TPA MC	29	33	35	28	27	27	27
Average of Surface Fuel TPA PO	20	23	25	18	19	19	20
Average of CWD 3”+ TPA MC	10	12	14	12	13	12	12
Average of CWD 3”+ TPA PO	8	9	10	8	9	9	9
Average of Surface Herb TPA MC	0.21	0.21	0.20	0.24	0.26	0.24	0.24
Average of Surface Herb TPA PO	0.21	0.21	0.21	0.23	0.23	0.22	0.22
Average of Surface Shrub TPA MC	0.40	0.37	0.34	0.63	0.73	0.55	0.65
Average of Surface Shrub TPA PO	0.23	0.23	0.23	0.24	0.24	0.24	0.25
Average of ALL_BA1 MC	1	1	1	0	0	0	0
Average of ALL_BA1 PO	1	1	1	0	0	0	0
Average of ALL_BA2 MC	15	15	14	7	3	8	5
Average of ALL_BA2 PO	13	16	18	5	3	8	7
Average of ALL_BA3 MC	49	51	52	28	23	31	26
Average of ALL_BA3 PO	47	47	47	27	22	30	27
Average of ALL_BA4 MC	51	52	56	37	36	36	37
Average of ALL_BA4 PO	42	46	48	35	35	37	37
Average of ALL_BA5 MC	30	38	43	31	33	30	33
Average of ALL_BA5 PO	22	25	28	23	25	23	25
Average of ALL_BA6 MC	26	29	32	28	31	26	29
Average of ALL_BA6 PO	18	20	22	19	21	19	21

In PACs, modelling shows that Trees per Acre is reduced in the action alternatives (2 and 3) as larger trees occupy more of this habitat type through time. The stand density index is also reduced as competition is lowered by treatments in PACs. A linear regression from basal area was used to estimate canopy cover. These estimates indicate that treatments would align with MSO Recovery Plan recommendations in mixed conifer with canopy cover higher than 60 percent and in pine oak, with canopy cover much higher than the recommended 40 percent, measuring above 60 percent in the action alternatives. The overall effect of treatments in PACs would be to increase large trees, as the quadratic mean diameter in inches is increased in Alternatives 2 and 3. Further, the current condition is maintained for the basal area average of all trees greater than 18 to 24 inches in diameter and the average of all trees greater than 24 inches in diameter in Alternatives 2 and 3. Shrub and herbaceous biomass would also be maintained or increase in Alternatives 2 and 3. Maintaining the current condition in PACS, while reducing risk of crown fire and the fire hazard index (decreasing fuel loading), and increasing coarse woody debris, downed logs, and snags of all size classes, are desired effects from treatments on MSO protected habitat.

Nest/Roost Recovery Habitat

Though these areas are distinct from PACs, their management objectives are similar. Any treatment proposed within MSO nest/roost recovery habitat should be designed specifically to maintain or accelerate the trajectory of these stands towards desired habitat conditions in the foreseeable future. Achieving management objectives within MSO recovery habitat can be addressed with the flexible toolbox approach. Stands in recovery habitat would be assigned a treatment using the decision matrices in the Flexible Toolbox Approach for Mechanical Treatments and with associated design features (Appendix C).

Table 69 shows the modeled effects from vegetation treatments by alternative to key MSO habitat variables in MSO Nest/Roost Recovery Habitat. As within PACs, the results of the action alternatives in MSO Nest/Roost Recovery habitat are that, while slightly reducing some variables in PACs, the treatments would maintain or increase most variables while treating and ultimately conserving these conditions over time.

Preserving MSO habitat by using thinning and burning treatments, while promoting large trees and reducing risk of fire hazard index and crown fire, is one of the main objectives of the action alternatives in Rim Country (returning resiliency to the forested ecosystem). Reducing trees per acre and the stand density index would greatly reduce competition in stands which, in conjunction with silvicultural prescriptions, would promote growth of large trees. These estimates indicate that treatments would align with MSO Recovery Plan recommendations, staying above 60 percent canopy cover in mixed conifer and well above 40 percent in pine oak. As with PACs, reducing the overall basal area average and canopy cover is not a desired outcome of treatment; however, reducing trees per acre and the stand density index would greatly reduce competition in stands which, in conjunction with silvicultural prescriptions, would promote growth of large trees. The quadratic mean diameter in inches would increase with the action alternatives, showing that this trend toward larger trees would be achieved. Increases in snags of all size classes and increases in shrub and herbaceous biomass are desired outcomes from treatments. Reductions in surface fuel and creation of interspaces and uneven-aged management would conserve MSO Nest/Roost Recovery habitat over time. Fire hazard index and risk of crown fire would be greatly reduced as a result of treatment (see Fire Ecology section for effects from the action alternatives).

Table 69. FVS Modeled Effects on Key Habitat Variables in MSO Nest/Roost Recovery Habitat

NR Recovery MC = 11,065 Acres Modeled PO = 13,539 Acres Modeled GM = 3,940 Acres Modeled on Tonto NF	Existing	No Action 2029	No Action 2039	Alt 2 2029	Alt 2 2039	Alt 3 2029	Alt 3 2039
Avg of Trees per Acre MC	1100	982	873	167	116	204	155
Avg of Trees per Acre PO	1280	1167	1052	217	137	521	432
Avg of Trees per Acre GM	1351	1231	1134	161	109	231	176
Avg of Basal Area MC	188	199	209	126	127	122	124
Avg of Basal Area PO	164	172	178	114	112	127	127
Avg of Basal Area GM	190	196	199	107	102	109	106
Avg of Stand Density Index MC	420	431	438	208	197	208	199
Avg of Stand Density Index PO	369	377	380	200	183	243	231
Avg of Stand Density Index GM	441	444	445	182	164	195	179
Avg of Quadratic Mean Diameter in Inches MC	6	7	8	14	16	13	15
Avg of Quadratic Mean Diameter in Inches PO	7	7	8	12	14	11	13

NR Recovery MC = 11,065 Acres Modeled PO = 13,539 Acres Modeled GM = 3,940 Acres Modeled on Tonto NF	**Existing**	**No Action 2029**	**No Action 2039**	**Alt 2 2029**	**Alt 2 2039**	**Alt 3 2029**	**Alt 3 2039**
Avg of Quadratic Mean Diameter in Inches GM	6	6	6	12	14	12	6
Average of SNAG 12-18” MC	4	4	4	5	3	5	3
Average of SNAG 12-18” PO	3	4	4	5	4	5	4
Average of SNAG 12-18” GM	3	4	3	6	4	6	4
Average of SNAG 18-24” MC	1	1	2	2	2	2	2
Average of SNAG 18-24” PO	1	1	1	2	2	1	2
Average of SNAG 18-24” GM	1	1	1	2	1	1	1
Average of SNAG ≥ 24” MC	1	1	1	1	1	1	1
Average of SNAG ≥ 24” PO	0	0	0	1	1	1	1
Average of SNAG ≥ 24” GM	0	0	0	1	1	1	1
Percent CANCOV Regression from BA MC	76	78	79	66	66	65	65
Percent CANCOV Regression from BA PO	73	74	76	64	62	66	66
Percent CANCOV Regression from BA GM	77	77	78	61	60	62	61
Avg of Surface Fuel tons per acre MC	30	34	37	24	23	23	22
Avg of Surface Fuel tons per acre PO	19	23	26	17	18	19	19
Avg of Surface Fuel tons per acre GM	23	27	29	19	18	20	19
Avg of Coarse Woody Debris 3”+ tons per acre MC	10	12	14	10	10	10	10
Avg of Coarse Woody Debris 3”+ tons per acre PO	6	8	9	8	8	8	8
Avg of Coarse Woody Debris 3”+ tons per acre GM	10	12	13	11	11	11	11
Avg of Herbaceous tons per acre MC	0.21	0.20	0.20	0.26	0.26	0.25	0.26
Avg of Herbaceous tons per acre PO	0.21	0.21	0.21	0.24	0.24	0.23	0.23
Avg of Herbaceous tons per acre GM	0.20	0.20	0.20	0.25	0.23	0.25	0.23
Average of Shrubs tons per acre MC	0.40	0.37	0.34	0.74	0.78	0.70	0.73
Average of Shrubs tons per acre PO	0.22	0.22	0.22	0.19	0.19	0.21	0.20
Average of Shrubs tons per acre GM	0.25	0.24	0.25	0.30	0.30	0.31	0.30
Avg of ALL BA1 0-1” MC	1	1	0	0	0	0	0
Avg of ALL BA1 0-1” PO	1	1	0	0	0	0	0

NR Recovery MC = 11,065 Acres Modeled PO = 13,539 Acres Modeled GM = 3,940 Acres Modeled on Tonto NF	Existing	No Action 2029	No Action 2039	Alt 2 2029	Alt 2 2039	Alt 3 2029	Alt 3 2039
Avg of ALL BA1 0-1” GM	1	1	1	0	0	0	0
Avg of ALL BA2 1-5” MC	12	12	13	1	1	2	2
Avg of ALL BA2 1-5” PO	10	11	13	2	1	3	3
Avg of ALL BA2 1-5” GM	14	15	16	1	1	2	2
Avg of ALL BA3 5-12” MC	39	40	39	13	10	15	12
Avg of ALL BA3 5-12” PO	41	40	38	16	12	22	19
Avg of ALL BA3 5-12” GM	54	53	51	14	11	17	14
Avg of ALL BA4 12-18” MC	61	59	58	32	29	33	30
Avg of ALL BA4 12-18” PO	54	54	54	34	32	38	35
Avg of ALL BA4 12-18” GM	61	62	63	31	27	33	29
Avg of ALL BA5 18-24” MC	43	52	57	44	45	42	43
Avg of ALL BA5 18-24” PO	37	44	47	39	41	41	42
Avg of ALL BA5 18-24” GM	31	36	38	33	31	31	31
Avg of ALL BA6 24” + MC	32	36	42	35	42	31	37
Avg of ALL BA6 24” + PO	21	23	25	23	27	23	27
Avg of ALL BA6 24” + GM	28	29	31	27	33	26	30

Foraging/Non-breeding Recovery Habitat

Design features (Appendix C) are included in both action alternatives, to use the following guidelines from the most current Mexican Spotted Owl Recovery Plan in Mexican spotted owl recovery foraging/non-breeding habitat:

- Crown spacing between tree groups (interspace) would average 25 to 60 feet distance, providing for forest health, prey habitat development, and to move toward or facilitate stand conditions more conducive to low-severity fire.
- Tree thinning in pine-oak would target 40 to 110 basal area; thinning in mixed conifer would target 40 to 135 basal area. The goal is to manage for a sustainable range of density and structural characteristics.
- No trees greater than 24 inches in diameter would be cut and trees greater than 18 inches would be retained, unless overriding management situations require their removal.

Table 70 shows the modeled effects from vegetation treatments by alternative to key MSO habitat variables in pine-oak, mixed conifer, and modeled recovery habitat on the Tonto National Forest in MSO Foraging/Non-breeding Recovery Habitat.

Table 70. FVS Modeled Effects on Key Habitat Variables in MSO Foraging/Non-breeding Recovery Habitat

Foraging/Non-breeding Recovery MC = 21,220 Acres Modeled PO = 85,458 Acres Modeled GM = 31,659 Acres Modeled on Tonto NF	Existing	No Action 2029	No Action 2039	Alt 2 2029	Alt 2 2039	Alt 3 2029	Alt 3 2039
Average of tpa MC	1398	1242	1101	154	97	377	304
Average of tpa PO	1192	1067	952	153	81	479	394
Average of tpa GM	1443	1308	1196	107	73	289	244
Average of BA MC	157	170	182	76	75	89	91
Average of BA PO	140	150	158	68	66	96	98
Average of BA GM	170	177	182	63	59	84	82
Average of SDI MC	376	394	406	133	121	172	165
Average of SDI PO	329	343	351	123	108	198	192
Average of SDI GM	407	414	416	108	95	162	151
Average of QMD MC	5	6	6	12	14	11	13
Average of QMD PO	6	6	7	11	14	10	12
Average of QMD GM	5	6	6	12	14	11	13
Average of SNAG 12-18” MC	3	3	3	4	3	4	3
Average of SNAG 12-18” PO	2	2	3	4	3	3	3
Average of SNAG 12-18” GM	2	2	2	5	3	5	3
Average of SNAG 18-24” MC	1	1	1	2	2	2	2
Average of SNAG 18-24” PO	1	1	1	1	1	1	1
Average of SNAG 18-24” GM	1	0	0	2	2	1	1
Average of SNAG ≥ 24” MC	1	1	0	1	1	1	1
Average of SNAG ≥ 24” PO	0	0	0	0	0	0	0
Average of SNAG ≥ 24” GM	0	0	0	1	1	1	1
Percent CANCOV Regression from BA MC	71	74	75	51	51	56	57
Percent CANCOV Regression from BA PO	69	70	72	48	47	59	59
Percent CANCOV Regression from BA GM	74	75	76	46	45	54	53
Average of Surface Fuel TPA MC	24	28	32	17	15	19	18
Average of Surface Fuel TPA PO	16	20	22	12	12	15	15
Average of Surface Fuel TPA GM	19	22	24	13	12	15	14
Average of CWD 3”+ TPA MC	8	10	12	9	8	9	8
Average of CWD 3”+ TPA PO	5	6	8	6	6	6	6
Average of CWD 3”+ TPA GM	6	7	9	8	7	7	7
Average of Surface Herb TPA MC	0.21	0.20	0.20	0.27	0.27	0.26	0.26
Average of Surface Herb TPA PO	0.21	0.21	0.21	0.26	0.25	0.24	0.24
Average of Surface Herb TPA GM	0.19	0.19	0.19	0.26	0.26	0.25	0.25
Average of Surface Shrub TPA MC	0.29	0.28	0.26	0.68	0.71	0.62	0.65

Foraging/Non-breeding Recovery MC = 21,220 Acres Modeled PO = 85,458 Acres Modeled GM = 31,659 Acres Modeled on Tonto NF	Existing	No Action 2029	No Action 2039	Alt 2 2029	Alt 2 2039	Alt 3 2029	Alt 3 2039
Average of Surface Shrub TPA PO	0.22	0.23	0.23	0.20	0.17	0.22	0.21
Average of Surface Shrub TPA GM	0.27	0.26	0.26	0.35	0.34	0.33	0.31
Average of ALL_BA1 MC	1	1	1	0	0	0	0
Average of ALL_BA1 PO	1	1	1	0	0	0	0
Average of ALL_BA1 GM	1	1	1	0	0	0	0
Average of ALL_BA2 MC	15	18	19	2	1	4	4
Average of ALL_BA2 PO	11	13	14	1	1	5	5
Average of ALL_BA2 GM	16	17	18	1	0	4	4
Average of ALL_BA3 MC	47	46	45	10	7	16	13
Average of ALL_BA3 PO	48	47	46	11	7	24	21
Average of ALL_BA3 GM	64	64	62	8	5	19	16
Average of ALL_BA4 MC	48	51	54	20	18	24	23
Average of ALL_BA4 PO	44	49	50	21	19	30	30
Average of ALL_BA4 GM	49	52	54	19	16	25	23
Average of ALL_BA5 MC	28	34	39	26	26	26	27
Average of ALL_BA5 PO	22	26	30	21	22	22	24
Average of ALL_BA5 GM	22	24	27	20	21	21	22
Average of ALL_BA6 MC	17	20	23	19	23	19	23
Average of ALL_BA6 PO	13	15	16	15	17	15	17
Average of ALL_BA6 GM	17	19	20	16	16	16	17

In MSO Foraging/Non-breeding Recovery habitat, treatments would maintain or increase most habitat variables beneficial to the MSO, its critical habitat, and its prey species, while conserving these conditions over time Table 70. These treatments would preserve Foraging/Non-Breeding Recovery habitat by thinning and burning while promoting large trees and reducing the fire hazard index and the risk of crown fire. A linear regression from basal area was used to estimate canopy cover. These estimates indicate that treatments would align with MSO Recovery Plan recommendations. The quadratic mean diameter in inches would increase with the action alternatives, showing that this trend toward larger trees would be achieved. Increases in snags of all size classes and increases in shrub and herbaceous biomass are desired outcomes from treatment. Reductions in surface fuel and creation of interspaces and uneven aged management would conserve MSO Foraging/Non-Breeding Recovery habitat over time. Fuel loads, the fire hazard index, and the risk of crown fire would be greatly reduced as a result of treatments (see Fire Ecology section for effects from the action alternatives).

Alternative 2 – Proposed Action

Under Alternative 2, mechanical treatments would occur in portions of all MSO habitats, except for core areas which would be only be burned (Table 71). Total treatments in MSO habitat include 241,585 acres of mechanical thinning and low-severity prescribed fire (about 71 percent of the total MSO habitat in the project area). This represents the largest number of MSO habitat acres ever treated with prescribed fire. The minimum post-treatment basal area for nesting and roosting habitat would be 110 square feet per acre. Adjustments would be made during implementation to retain a basal area of at least 110 square feet per acre wherever possible. Low-severity prescribed fire would be applied to all MSO habitats. No trees greater than 24 inches in diameter would be cut in MSO habitat. Trees up to 18 inches in diameter could be thinned in PACs. Treatments in recovery nest/roost habitat would be designed to move forests toward nest/roost habitat conditions. Treatments in nest/roost habitat would not lower forest structure values below the minimum nest/roost levels described in the forest plans and in Table C.3 of the Revised Recovery Plan (USDI FWS 2012b). It is assumed that mechanical treatments and two low-severity fires would be implemented during the project's lifespan (2019-2049).

Mechanical thinning and low-severity prescribed fire would take place at different times in different locations. MSO habitat could be affected by mechanical treatments in one area while prescribed fire occurs in another area in the same period of time. It is anticipated that implementation of all proposed treatments would require 20 or more years to complete.

Table 71. Alternative 2 thinning and burning treatments in MSO habitat

Treatment Type	Protected Habitat	Nest/roost Recovery	Foraging/Non-Breeding Recovery	Total Acres
Prescribed Fire Only[1]	49,066	None	None	49,066
Thinning+ Prescribed Fire	24,873	28,235	138,801	191,909
Prescribed Burns in Core Areas	610	N/A	N/A	610
Total	74,549	28,235	138,801	241,585
No Proposed Treatments	7,075	None	None	7,075
Total Analysis Acres	81,624	28,235	138,801	248,660

1. A single prescribed fire may include burning piles and a follow-up broadcast burn. Prescribed fire would be implemented as indicated by monitoring data to augment wildfire acres, with the expectation that desired conditions would require a fire return interval of about 10 years.
2. These areas would be treated as planned through other NEPA decisions for other project areas

Table 72. Acres of Treatments in MSO Habitat Types, Alternative 2

MSO Habitat Type	Cover Type	Aspen	Grass land or Meadow	Madrean Pinyon Oak	M/C with Aspen	Mixed Conifer Frequent Fire	Other	PJ	Ponderosa Pine	Ponderosa Pine/Evergreen Oak	Riparian	Total
Protected	PAC	169	123	945	324	11,265	622	4,468	41,741	6,260	1,699	67,617
PAC Core	PAC - Core Area	64	18	339	145	3,961	16	758	6,281	1,452	434	13,469
Recovery Replacement Nest/Roost	Recovery Replacement Nest/Roost	0	278	246	613	9,327	0	56	13,318	3,317	1,079	28,235
Recovery Replacement Nest/Roost	Modeled recovery habitat (Tonto NF)	0	0	246	0	0	0	56	1,796	1,653	265	4,017
Recovery Replacement Nest/Roost	Mixed Conifer	0	86	0	613	9,327	0	0	376	0	372	10,774
Recovery Replacement Nest/Roost	Pine-Oak	0	192	0	0	0	0	0	11,146	1,664	442	13,444
Recovery Foraging/Non-Breeding	Recovery Foraging/Non-Breeding	0	459	2,176	1,424	17,391	486	1,017	79,328	34,031	2,490	138,801
Recovery Replacement Nest/Roost	Modeled recovery habitat (Tonto NF)	0	0	2,176	0	0	486	904	8,461	18,597	1160	31,786
Recovery Replacement Nest/Roost	Mixed Conifer	0	159	0	1,424	17,391	0	0	1,095	777	573	21,418
Recovery Replacement Nest/Roost	Pine-Oak	0	299	0	0	0	0	113	69,772	14,657	757	85,598
Grand Total	**Grand Total**	**233**	**878**	**3,707**	**2,506**	**41,943**	**1,125**	**6,299**	**140,668**	**45,061**	**5,703**	**248,123**

Protected Habitat

There are 196 PACs (110,890 acres) within the project area. Approximately 7,075 acres occur in other project areas that overlap with the Rim Country project area but would be treated as those projects were planned and consulted on with the FWS. Approximately 17, 500 acres that also occur in other overlapping project areas would have some other type of restoration (riparian, wet meadow, grassland, aspen). Under Alternative 2, 81,624 acres (73 percent) of protected MSO habitat are proposed for thinning and/or burning or other restoration activities. Therefore, most of the protected habitat of the PACs in the Rim Country project area not associated with other projects would have some type of vegetation treatment. Most vegetation treatments (greater than 60 percent) would be prescribed fire only. Little change would occur in forest structure and MSO prey habitat from low-severity fire treatments.

In PACs, Alternative 2 would allow cutting trees up to 18 inches in diameter. All stands identified for mechanical thinning would be marked by hand and marking would be coordinated with the FWS. No mechanical treatments would occur in core areas. Design features (Appendix C) were included to minimize effects on owls and to promote Primary Constituent Habitat Elements recommended by the MSO Recovery Plan and the forest plans. Mechanical treatments in PACs are summarized in the Effects Common to Both Action Alternatives section. The Mechanical Treatments Flexible Toolbox Approach contains the following language for treatments in PACs:

PACs exhibit a variety of topographic and forest conditions and occupied PACs can already be considered successful nesting habitat. Mechanical treatments in PACs should be designed to maintain or improve the characteristics that make each PAC effective at providing habitat while also making them resilient to disturbance. Consideration should be given to 1) increasing the number of large trees; 2) creating additional foraging habitat for MSO; 3) the fire hazard index in the PAC and whether it is in wildland-urban interface (WUI); 4) restoration/protection of other resource values nearby, such as perennial water; and 5) protecting other values at risk. Treating areas near PACs should be considered in order in improve resiliency in the PACs themselves. PACs should be treated with consideration of the larger landscape and not just separate entities. Specific treatments in PACs would be determined prior to implementation and in consultation with U.S. Fish and Wildlife Service (FWS) personnel.

Table 73. Summary of treatments in PACs, Alternative 2

Proposed Treatment	- Alternative 2 - Modified Proposed Action Acres
PAC - Aspen Restoration	28
PAC - Facilitative Operations Mechanical	301
PAC - Facilitative Operations Prescribed Fire Only	6,882
PAC - Grassland Prescribed Fire Only	41
PAC - Grassland Restoration	23
PAC – Mechanical	17,464
PAC - Prescribed Fire Only	50,832
PAC - Riparian Prescribed Fire Only	911
PAC - Riparian Restoration	1,775
PAC - Severe Disturbance Area Treatment	3,606
PAC - Wet Meadow & Riparian Prescribed Fire Only	32
PAC - Wet Meadow & Riparian Restoration	98
PAC - Wet Meadow Prescribed Fire Only	33
PAC - Wet Meadow Restoration	254
Total	**82,279**

Forest Structure

Under Alternative 2, the FVS modeling of treatments over the next 30 years indicates that most forest structure, as it pertains to habitat variables important to the MSO in PACs, is preserved through time. Trees per acre would be reduced from the existing 1,291 in mixed conifer and 1,276 in pine-oak, to 227 in mixed conifer and 232 in pine-oak in 2039 (Table 68). Reducing trees per acre closer to NRV protects PACs and restores conditions for MSO by managing for less dense and encroached forested conditions. Openings created by bringing tree size classes to desired condition would provide habitat for a variety of prey species and would slow or reduce fire severity by breaking the continuity of dense tree canopies and ladder fuels.

The average of all basal areas from saplings (Size Class 1) to old growth or large trees (Size Class 6) show that intermediate-sized trees (Size 3 with BA 5 to 12 inches and Size 4 with BA 12 to 18 inches are currently predominant on the landscape and vastly departed from NRV) would be lowered closer to desired condition as a result of treatments through 2049. The basal area average would be decreased from the existing 173 in mixed conifer and 144 in pine-oak, to 127 in mixed conifer and 106 in pine-oak in 2039. Increase in basal area size classes for older trees and reducing medium-aged over-abundant size classes to NRV would benefit the MSO through reduction of over-encroached forest conditions. Further, this would increase vertical and horizontal habitat heterogeneity providing roosting options, thermal and hiding cover for the MSO and habitat for a variety of prey species.

The percent average canopy cover would be reduced from an existing 74 percent in mixed conifer and 69 percent in pine-oak, to 66 percent in mixed conifer and 61 percent in pine-oak in 2039. Retaining canopy cover allows for a thermal environment needed for nesting and roosting conditions for the MSO while allowing for prey base and for species that require interlocking crown habitat. Design features (Appendix C) would preserve the recommended habitat conditions in PACs wherever possible, while protecting this habitat from severe fire intensity or stand-replacing effects from crown fire (see the Fire Effects section for Alternative 2 below).

Promotion of large tree growth would be achieved from proposed treatments in Alternative 2 as stand density index would change from the existing 398 in mixed conifer and 339 in pine-oak, to 218 in mixed conifer and 191 in pine-oak in 2039.

A reduction in SDI competition would increase the quadratic mean diameter from the existing 6 inches in both mixed conifer and pine-oak, to 12 inches in mixed conifer and 11 inches in pine-oak in 2039. By emphasizing large trees, this should also provide for MSO life history needs (nesting and roosting) and provide for large snags and logs (Gainey et al. 2003).in 2049.

Alternative 2 Snags
In PACs, standing snags, coarse woody debris, and downed logs over 12 inches would all increase or be maintained as a result of treatments under Alternative 2 (Table 68). These Primary Constituent Element habitat variables important to the MSO and MSO prey species would be preserved over time under this action alternative.

Snags 12 to 18 inches in diameter would increase from four per acre in mixed conifer and two per acre in pine-oak to five per acre in both cover types in 2039. Snags 24 inches in diameter and greater would increase from one per acre in mixed conifer and 0 in pine-oak (existing) to one per acre in both cover types over 20 years. Retaining/increasing key habitat elements for the MSO such as snags of various sizes to provide for nesting and roosting and for prey habitat follows guidance from the MSO Revised Recovery Plan (2012). This is a long-term benefit to the MSO as a result of treatments in Alternative 2.

Alternative 2 Coarse Woody Debris and Understory
In PACs, large downed logs 12 or more inches in size would increase from one to four tons per acre as a result of treatments over 30 years. Coarse woody debris would increase from the existing 5.68 tons per acre to 7.61 tons per acre in 2049.

Herbaceous biomass in tons per acre would increase slightly over 20 years. The existing 0.2 tons per acre in both mixed conifer and pine-oak cover types would increase to 0.26 tons per acre in mixed conifer and 0.23 tons per acre in pine-oak in 2039. Treatments would move the existing shrub biomass from 0.40 tons per acre in mixed conifer to 0.73 in 2039. Increasing these habitat variables important to prey base for the MSO would be an added benefit from treatments in PACs in this alternative.

Alternative 2 Fire Effects
Surface fuel loading in MSO Protected Habitat would be reduced under Alternative 2, moving from an existing 29 tons per acre in mixed conifer and 20 tons per acre in pine-oak, to 27 tons per acre in mixed conifer and 19 in pine-oak in 2039.

Fire modeling in PACs for Alternative 2 shows the least benefit from treatment compared to other habitat types, as the objective in PACs is to provide interlocking crowns with larger proportions of woody debris and snags which can serve as ladder fuels. This complicates quantifying effects from treatments showing fewer acres of protected habitat benefiting from treatment than in surrounding habitats (see Recovery Habitat analyses below). Further, by analyzing the highest hazard categories for Fire Hazard Index and potential for active crown fire, treatment in PACs shows greater differences/benefits for preserving existing protected habitat while treating surrounding habitats at a higher level.

Fire Hazard Index would decrease from Alternative 2 from 91,697 acres (76 percent of the PACs in the project area in need of treatment) in existing condition to 83,832 acres (69 percent). The highest and extreme need for treatment categories of Fire Hazard Index from Alternative 2 in PACs would be 33,410 acres (27 percent) of all PACs in the project area expected to experience high-severity wildfire. This is decreased from 49,888 acres (41 percent) of all PACs in the existing condition. Reductions of this magnitude should preserve existing MSO habitat while encouraging conditions to create more over time through recovery habitats.

The potential for active and conditional crown fire would be decreased in Alternative 2 from 58,243 acres (48 percent) to 34,068 acres (28 percent) of this habitat type modelled that would experience high-severity crown fire as a result of treatment (Table 67).

Alternative 2 Nest/Roost Recovery

There are 39,461 acres of Nest/Roost Recovery Habitat in the Rim Country project area. Many of these acres (28,554 acres or 72 percent) could receive thinning and fire treatments under Alternative 2. The Mechanical Treatments Flexible Toolbox Approach (Appendix D) states the following for Nest/Roost Recovery Habitat:

Though these areas are distinct from PACs, their management objectives are similar. Any treatment proposed within MSO nest/roost recovery habitat should be designed specifically to maintain or accelerate the trajectory of these stands towards desired habitat conditions in the foreseeable future.

Table 74. Mechanical and Fire Treatments in MSO Nest/Roost Recovery Habitat, Alternative 2

Proposed Treatment	Alternative 2 - Modified Proposed Action Acres
Mixed Conifer Recovery NR	11,065
Facilitative Operations Mechanical	577
Facilitative Operations Prescribed Fire Only	38
MSO Recovery - Replacement Nest/Roost	9,579
Prescribed Fire Only	165
Riparian Prescribed Fire Only	21
Riparian Restoration	510
Wet Meadow & Riparian Restoration	33
Wet Meadow Restoration	143
Pine-Oak Recovery NR	13,539
Grassland Restoration	71
MSO Recovery - Replacement Nest/Roost	12,328
Prescribed Fire Only	270
Riparian Prescribed Fire Only	69
Riparian Restoration	596
Wet Meadow & Riparian Prescribed Fire Only	148
Wet Meadow & Riparian Restoration	4
Wet Meadow Restoration	53
Modeled Recovery NR (Tonto NF)	3,940
Facilitative Operations Mechanical	303
MSO Recovery - Replacement Nest/Roost	3,324
Riparian Restoration	313
Grand Total	28,554

Alternative 2 Forest Structure

Under Alternative 2, the FVS modeling from treatments over the next 30 years indicate that most forest structure, as it pertains to habitat variables important to the MSO in MSO Nest/Roost Recovery habitat, would be preserved through time. Trees per acre would be reduced from the existing 1,100 in mixed conifer, 1,280 in pine-oak, and 1,351 using the modeled recovery habitat on the Tonto, to 116 in mixed conifer, 137 in pine-oak, and 109 using the modeled recovery habitat on the Tonto. Reducing trees per acre closer to NRV would protect Nest/Roost Recovery habitat and restore conditions for the MSO by managing for less dense and encroached forested conditions. Openings created by bringing these size classes into desired condition would provide habitat for a variety of prey species and would slow or reduce fire severity by breaking the continuity of dense tree canopies and ladder fuels.

The average of all basal areas from saplings (Size Class 1) to old growth (Size Class 6) show that intermediate-sized trees (Size 3 with BA 5-12 inches and Size 4 with BA 12-18 inches are currently predominant on the landscape and vastly departed from NRV) would be lowered closer to desired condition as a result of treatments through 2039. Increasing basal area Size classes for older trees and reducing medium-aged over-abundant size classes to NRV benefits the MSO through the reduction of over-encroached forest conditions. Further, this would increase vertical and horizontal habitat heterogeneity providing roosting options, and thermal and hiding cover for the MSO and habitat for a variety of prey species.

The basal area average would decrease from the existing 188 in mixed conifer, 164 in pine-oak, and 190 in modeled recovery habitat on the Tonto, to 127 in mixed conifer, 112 in pine-oak, and 102 in modeled recovery habitat on the Tonto in 2029. The percent average canopy cover would be reduced from the existing 76 percent in mixed conifer, 73 percent in pine-oak, and 77 percent in modeled recovery habitat on the Tonto, to 66 percent in mixed conifer, 62 percent in pine-oak, and 60 percent in modeled recovery habitat on the Tonto in 2029. Design features for the project would preserve the recommended habitat conditions in Recovery Habitat wherever possible, while protecting this habitat from severe fire intensity or stand-replacing effects from crown fire.

Retaining canopy cover allows for a thermal environment needed for nesting and roosting conditions for the MSO while allowing for prey base and for species that require interlocking crown habitat. Promotion of large tree growth would be achieved in Alternative 2 from proposed treatments as stand density index would change from 420 in mixed conifer, 369 in pine-oak, and 441 in modeled recovery habitat on the Tonto, to 197, 183, and 164, respectively, in 2029. Reduction in stand density index competition would increase the quadratic mean diameter from the existing six inches in mixed conifer, seven in pine-oak, and six in modeled recovery habitat on the Tonto, to 16 inches in mixed conifer, and 14 inches in both pine-oak and the modeled recovery habitat on the Tonto in 2029. By emphasizing for large trees, this should also provide for MSO life history needs (nesting and roosting) and provide large snags and logs (Gainey et al. 2003).

Alternative 2 Snags

In Nest/Roost Recovery Habitat, snags would generally increase or be maintained as a result of treatments under Alternative 2 (Table 69). These Primary Constituent Element habitat variables important to the MSO and MSO prey species would be preserved over time under this action alternative. Retaining/increasing key habitat elements for the MSO, such as snags of various sizes to provide for nesting and roosting and for prey habitat, follows guidance from the MSO Revised Recovery Plan (2012). This is a long-term benefit to the MSO as a result of treatments under Alternative 2.

Alternative 2 Coarse Woody Debris and Understory

Coarse woody debris greater than three inches would be maintained at 10 tons per acre in mixed conifer and increases in pine-oak from six trees per acre to eight trees per acre in 2029. Using the modeled recovery habitat on the Tonto, coarse woody debris would increase from 10 trees per acre to 11 trees per acre in 2029. Herbaceous biomass would increase over the 20 years modeled in mixed conifer and in the modeled recovery habitat on the Tonto. The existing condition of 0.21 tons per acre in mixed conifer and 0.20 in modeled recovery habitat on the Tonto would increase to 0.26 in mixed conifer and 0.23 in modeled recovery habitat on the Tonto in 2039. More pronounced is the effect of treatments on the shrub biomass, which would change from 0.40 tons per acre in mixed conifer to 0.78 in 2029. In acres identified using the modeled recovery habitat on the Tonto, shrub biomass would increase from 0.25 tons per acre to 0.30 tons per acre in 2029. Increasing these habitat variables important to prey base for the MSO would be an added benefit to treatments in Nest/Roost Recovery habitat under this alternative.

Alternative 2 Fire Effects

Surface fuel loading in MSO Nest/Roost Recovery habitat would be reduced under Alternative 2, moving from 30 tons per acre in mixed conifer, 19 in pine-oak, and 23 in modeled recovery habitat on the Tonto, to 23 tons per acre in mixed conifer and 18 tons per acre in pine-oak and modeled recovery habitat on the Tonto in 2029 (Table 69).

Fire Hazard Index would be decreased from 4,175 acres (41 percent of the Nest/Roost Recovery habitat in high or extreme need of treatment) to 588 acres (six percent). Reductions of this magnitude should preserve existing MSO habitat while encouraging conditions to create more over time through recovery habitats.

The potential for active and conditional crown fire would be decreased under Alternative 2 from 4,802 acres (47 percent) to 407 acres (four percent). Reducing active crown fires by this magnitude is a benefit to MSO and its critical habitat that would preserve Nest/Roost Recovery habitat over time.

Alternative 2 Other Habitat Effects

Understory vegetation development is related to the amount of solar radiation reaching the ground. This creates a direct and inverse relationship between canopy closure and herbaceous cover. The uncharacteristic forest structure existing in the ponderosa pine forests of northern Arizona restricts herbaceous growth well below pre-settlement conditions. Ponderosa pine forests in Arizona are relatively homogeneous and the site-specific habitat variability that springs, streams, meadows, grasslands, savannas, and aspen represent are important to a wide array of wildlife, including MSO prey species. These distinct vegetation types support understory vegetation that is typically denser, more continuous, and more diverse because of the soil types supporting them and the increased solar radiation and moisture availability compared to ground conditions in the general forest. Understory vegetation provides the food and cover that supports an array of wildlife, including many small mammals, birds, bats, and a variety of arthropods that serve as food for vertebrate species and pollinators to help maintain herbaceous diversity. These microhabitats directly and indirectly support MSO prey species. Improvements to springs, riparian areas, stream channels, meadows, and aspen can benefit MSOs in ways greater than simple area estimates indicate.

Springs, Riparian and Stream Habitat, Grasslands, Savannas, Meadows, and Aspen

Springs, riparian areas, and stream channel restoration would be the same for both action alternatives and are described above in the Effects Common to Both Action Alternatives section. Grassland, savanna, and meadow treatments would include mechanical tree removal and prescribed burning within PACs under both Alternatives 2 and 3.

Cumulative Effects Alternative 2 – Modified Proposed Action

Treatments in these areas would reduce the fire threat for MSO habitat within the respective project area, as well as reducing the threat of high-severity fire starting in these areas and burning habitat outside the project areas. Given the diameter limits employed and the generally low intensity of the treatments in MSO habitat, decreases in the risk of high-severity fire and improvements to understory vegetation and prey habitat are expected to be short term, before canopies expand and intercept light, rain, and snow, thereby reducing understory response in the long term.

Cumulative effects from reasonably foreseeable projects could include disturbance from noise and potentially from smoke. Implementation of the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim), could cumulatively degrade but retain MSO habitat, including PACs and recovery habitat, in the short and long terms. However, the risk of high-severity fire eliminating MSO habitat would be reduced in the short and long terms.

Although smoke and noise can cross project boundaries, both largely disperse with distance. However, some areas where smoke settles could be at further risk of effects on owls where these projects share boundaries. All or most PAC treatments would have timing restrictions, cumulatively preventing treatments during the breeding season. The most common PAC treatment would be prescribed fire.

Given the various stages of planning and implementation, most project effects would be dispersed both spatially and temporally. Projects in MSO habitat are typically designed to improve habitat, or to reduce fuel loading and risk of crown fire while retaining habitat function, resulting in a decrease in risk of high-severity fire. Cumulatively there could be increased disturbance to individual MSOs from noise or smoke in the short term. Given restoration project objectives, the scale of the cumulative effects area, the distribution of MSO habitat across the project area, and the length of time over which treatments would be implemented (20 years of implementation and ten more years of obtained benefits through reduction of wildfire risk), cumulatively alternative 2 is not expected to negatively affect MSO population in the long term. Cumulatively, treatments in MSO habitat should move forest conditions toward desired conditions and decrease the risk of habitat loss to large-scale high-severity fire.

Determination of Effect

Based on the above analysis, Alternative 2 of the 4FRI Rim Country Project **may affect, is likely to adversely affect the Mexican spotted owl.**

Alternative 3 – Focused Alternative

Protected Habitat

Approximately 61,695 acres are proposed for treatment in PACs under Alternative 3. Mechanical treatments could occur in 18,887 acres and are summarized below in Table 75.

Table 75. Treatments in MSO Protected Habitat, Alternative 3

Proposed Treatment	Alternative 3 Focused Alternative Acres
PAC - Aspen Restoration	28
PAC - Facilitative Operations Mechanical	301
PAC - Facilitative Operations Prescribed Fire Only	3,065
PAC - Grassland Prescribed Fire Only	41
PAC - Grassland Restoration	23
PAC – Mechanical	15,754
PAC - Prescribed Fire Only	37,964
PAC - Riparian Prescribed Fire Only	911
PAC - Riparian Restoration	1,775
PAC - Severe Disturbance Area Treatment	1,416
PAC - Wet Meadow & Riparian Prescribed Fire Only	32
PAC - Wet Meadow & Riparian Restoration	98
PAC - Wet Meadow Prescribed Fire Only	33
PAC - Wet Meadow Restoration	254
Grand Total	**61,695**

Alternative 3 Forest Structure

Under Alternative 3, the FVS modeling of treatments over the next 30 years indicates that most forest structure, as it pertains to habitat variables important to the MSO in PACs, is preserved through time. Trees per acre would be reduced from the existing 1,291 in mixed conifer and 1,276 in pine-oak, to 379 in mixed conifer and 368 in pine-oak in 2029 (Table 68). Reducing trees per acre closer to NRV protects PACs and restores conditions for MSO by managing for less dense and encroached forested conditions. Openings created by bringing tree size classes to desired condition would provide habitat for a variety of prey species and would slow or reduce fire severity by breaking the continuity of dense tree canopies and ladder fuels.

The average of all basal areas from saplings (Size Class 1) to old growth or large trees (Size Class 6) show that intermediate-sized trees (Size 3 with BA 5-12 inches and Size 4 with BA 12-18 inches are currently predominant on the landscape and vastly departed from NRV) would be lowered, but not to desired conditions, as a result of treatments through 2039. The basal area average would be decreased from the existing 173 in mixed conifer and 144 in pine-oak, to 130 in mixed conifer and 117 in pine-oak in 2039. These modeled results would align with the MSO Recovery Plan recommendations. Design features would preserve the recommended habitat conditions in PACs wherever possible, while protecting this habitat from severe fire intensity or stand-replacing effects from crown fire.

Promotion of large tree growth would be achieved in Alternative 3 as stand density index would change from the existing 398 in mixed conifer and 339 in pine-oak, to 235 in mixed conifer and 223 in pine-oak in 2039. A reduction in SDI competition would increase the quadratic mean diameter from the existing six inches in both mixed conifer and pine-oak, to 12 inches in mixed conifer and 10 inches in pine-oak in 2039.

Alternative 3 Snags

In PACs, standing snags, coarse woody debris, and downed logs over 12 inches would all be maintained or increase as a result of treatments under Alternative 3 (Table 68). These Primary Constituent Element habitat variables important to the MSO and MSO prey species would be preserved over time under this action alternative. Snags 12 to 18 inches in diameter would increase from two per acre to four per acre in 2039. The number of snags per acre, snags 24 inches in diameter and greater would be maintained in PACs over the 20 years modeled. Retaining/increasing key habitat elements for the MSO such as snags of various sizes to provide for nesting and roosting and for prey habitat follows guidance from the MSO Revised Recovery Plan (2012). This is a long-term benefit to the MSO as a result of treatments in Alternative 3.

Alternative 3 Coarse Woody Debris and Understory

In PACs, coarse woody debris three inches or greater would increase from 10 to 12 tons per acre in mixed conifer and from eight to nine tons per acre in pine-oak as a result of treatments over the 20 years modeled. Herbaceous biomass in tons per acre would increase slightly over 20 years. Proposed treatments would change the amount of shrub biomass from the existing 0.4 tons per acre in mixed conifer to 0.65 in 2039. Shrub biomass would slightly increase in pine-oak as a result of treatments over the 20 years modeled.

Alternative 3 Fire Effects

Surface fuel loading in MSO Protected Habitat would be slightly reduced under Alternative 3, moving from an existing 29 tons per acre in mixed conifer to 27 tons per acre in 2039.

Fire Hazard Index would decrease from 49,889 acres (41 percent of the PACs in the project area in need of treatment) to 33,105 acres (30 percent). Reductions of this magnitude should preserve existing MSO habitat while encouraging conditions to create more over time through recovery habitats. Active crown fire in PACs in Alternative 3 total 33,044 acres (30 percent) compared to the existing 58,243 (48 percent) that would experience high-severity crown fire as a result of treatments.

Alternative 3 Nest/Roost Recovery

Forest Structure

Under Alternative 3, the FVS modeling from treatments over the next 30 years indicate that most forest structure, as it pertains to habitat variables important to the MSO in MSO Nest/Roost Recovery habitat, would be preserved through time. Trees per acre would be reduced from the existing 1,100 in mixed conifer, 1,280 in pine-oak, and 1,351 using the modeled recovery habitat on the Tonto, to 155 in mixed conifer, 432 in pine-oak, and 176 using the modeled recovery habitat on the Tonto in 2039. Reducing trees per acre closer to NRV would protect Nest/Roost Recovery habitat and restore conditions for the MSO by managing for less dense and encroached forested conditions. Openings created by bringing these size classes into desired condition would provide habitat for a variety of prey species and would slow or reduce fire severity by breaking the continuity of dense tree canopies and ladder fuels.

Table 76. Treatments in MSO Nest/Roost Recovery Habitat, Alternative 3

Proposed Treatment	Alternative 3 Focused Alternative Acres
Mixed Conifer Recovery NR	10,458
Facilitative Operations Mechanical	577
Facilitative Operations Prescribed Fire Only	38
MSO Recovery - Replacement Nest/Roost	8,972
Prescribed Fire Only	165
Riparian Prescribed Fire Only	21
Riparian Restoration	510
Wet Meadow & Riparian Restoration	33
Wet Meadow Restoration	143
Pine-Oak Recovery NR	8,844
Grassland Restoration	71
MSO Recovery - Replacement Nest/Roost	7,643
Prescribed Fire Only	260
Riparian Prescribed Fire Only	69
Riparian Restoration	596
Wet Meadow & Riparian Prescribed Fire Only	148
Wet Meadow & Riparian Restoration	4
Wet Meadow Restoration	53
Modeled Recovery NR (Tonto NF)	3,531
Facilitative Operations Mechanical	302
MSO Recovery - Replacement Nest/Roost	2,916
Riparian Restoration	313
Grand Total	22,833

The average of all basal areas from saplings (Size Class 1) to old growth (Size Class 6) show that intermediate-sized trees (Size 3 with BA 5 to 12 inches and Size 4 with BA 12 to 18 inches are currently predominant on the landscape and vastly departed from NRV) would be lowered as a result of treatments through 2039. The basal area average would decrease from the existing 188 in mixed conifer, 164 in pine-oak, and 190 in modeled recovery habitat on the Tonto, to 124 in mixed conifer, 127 in pine-oak, and 106 in modeled recovery habitat on the Tonto in 2029. The percent average canopy cover would be reduced from the existing 76 percent in mixed conifer, 73 percent in pine-oak, and 77 percent in modeled recovery habitat on the Tonto, to 65 percent in mixed conifer, 66 percent in pine-oak, and 61 percent in modeled recovery habitat on the Tonto in 2039. Design features for the project would preserve the recommended habitat conditions in Recovery Habitat wherever possible, while protecting this habitat from severe fire intensity or stand-replacing effects from crown fire.

Promotion of large tree growth would be achieved in Alternative 3 as the stand density index changes from 420 in mixed conifer, 369 in pine-oak, and 441 in modeled recovery habitat on the Tonto, to 199, 231, and 179, respectively, in 2039. Reduction in stand density index competition would increase the quadratic mean diameter from the existing six inches in mixed conifer, seven in pine-oak, and six in modeled recovery habitat on the Tonto, to 15 inches in mixed conifer, and 13 inches in pine-oak, and 16 inches in modeled recovery habitat on the Tonto in 2039.

Alternative 3 Snags

In Nest/Roost Recovery Habitat, snags would be maintained or increase as a result of treatments under Alternative 3 (Table 69). These Primary Constituent Element habitat variables important to the MSO and MSO prey species would be preserved over time under the focused alternative.

Alternative 3 Coarse Woody Debris and Understory

In Nest/Roost Recovery habitat, coarse woody debris greater than three inches would increase as a result of treatments through 2039. Herbaceous biomass would increase over the 20 years under Alternative 3. The existing 0.21 tons per acre in mixed conifer and pine-oak and the 0.20 tons per acre in modeled recovery habitat on the Tonto would slightly increase. Shrub biomass would change from 0.40 tons per acre to 0.73 tons per acres in mixed conifer by 2039.Increasing these habitat variables important to prey base for the MSO would be an added benefit to treatments in Nest/Roost Recovery habitat under this alternative.

Alternative 3 Fire Effects

Surface fuel loading in MSO Nest/Roost Recovery habitat would be reduced under Alternative 3, moving from 30 tons per acre in mixed conifer, 19 in pine-oak, and 23 in modeled recovery habitat on the Tonto, to 22 tons per acre in mixed conifer, 19 in pine-oak, and 23 modeled recovery habitat on the Tonto, to 22 in mixed conifer, 19 in pine-oak, and 19 modeled recovery habitat on the Tonto in 2039 (Table 69).

Fire Hazard Index would be decreased from 4,175 acres (41 percent of the Nest/Roost Recovery habitat in high or extreme need of treatment) to 588 acres (six percent). Reductions of this magnitude should preserve existing MSO habitat while encouraging conditions to create more over time through recovery habitats.

The potential for crown fire would be decreased under Alternative 3 from 4,802 acres (47 percent) to 407 acres (four percent). Reducing active crown fires by this magnitude is a benefit to MSO and its critical habitat that would preserve Nest/Roost Recovery habitat over time.

Alternative 3 Other Habitat Effects

Understory vegetation development is related to the amount of solar radiation reaching the ground. This creates a direct and inverse relationship between canopy closure and herbaceous cover. The uncharacteristic forest structure existing in the ponderosa pine forests of northern Arizona restricts herbaceous growth well below pre-settlement conditions. Ponderosa pine forests in Arizona are relatively homogeneous and the site-specific habitat variability that springs, streams, meadows, grasslands, savannas, and aspen represent are important to a wide array of wildlife, including MSO prey species. These distinct vegetation types support understory vegetation that is typically denser, more continuous, and more diverse because of the soil types supporting them and the increased solar radiation and moisture availability compared to ground conditions in the general forest. Understory vegetation provides the food and cover that supports an array of wildlife, including many small mammals, birds, bats, and a variety of arthropods that serve as food for vertebrate species and pollinators to help maintain herbaceous diversity. These microhabitats directly and indirectly support MSO prey species. Improvements to springs, riparian areas, stream channels, meadows, and aspen can benefit MSOs in ways greater than simple area estimates indicate.

Alternative 3 Springs, Riparian and Stream Habitat, Grasslands, Savannas, Meadows, and Aspen

Springs, riparian areas, and stream channel restoration would be the same for both action alternatives and are described above in the Effects Common to Both Action Alternatives section. Grassland, savanna, and meadow treatments would include mechanical tree removal and prescribed burning within PACs under both Alternatives 2 and 3

Cumulative Effects Alternative 3 – Focused Alternative

Cumulatively, when added to other projects in the cumulative effects boundaries in MSO habitat, the areas not assigned treatments using the decision matrix would be 218,670 less in Alternative 3 than in Alternative 2. In PACs, 14,640 fewer acres would be thinned and burned. In Recovery Nest/Roost habitat, 5,820 fewer acres would be treated in Alternative 3. Cumulatively, savannah treatments in Alternative 3 would be reduced by 15,190 acres, providing less restoration to benefit the MSO prey base. While short-term effects from disturbance would be lessened slightly across the cumulatively effects area in Alternative 3, the long-term effects and risk of habitat degradation from stand-altering wildfire or insect infestations would be greater than under alternative 2 and when added to treatments in MSO habitat would improve fewer acres.

Determination of Effect

Based on the above analysis, Alternative 3 **may affect, is likely to adversely affect the Mexican spotted owl.**

Western Yellow-billed Cuckoo

Alternative 1 – No Action Direct and Indirect Effects

Under Alternative 1, habitat conditions for wildlife would largely remain in their current condition. Thinning and prescribed fire would still occur as a result of current and reasonably foreseeable projects. However, the landscape would continue to move away from desired conditions (see Affected Environment above and in the Silviculture and Fire Specialist reports). Alternative 1 would have no direct effect on the Yellow-billed Cuckoo; however there would be substantial indirect effects. Dense forest conditions would still occur and the high fire hazard potential would persist. Large crown-wildfires could adversely affect potential habitat by destroying understory and overstory vegetation. As a result overland flow would increase, and soil erosion would increase with potentially high sediment loads. Water quality and riparian conditions would be adversely affected on a wide-scale basis (See Hydrology Report), resulting in indirect adverse effects.

Under Alternative 1, there would be no restoration of springs and riparian areas. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (See Hydrology Report), resulting in degradation of potential habitat for cuckoos.

Denser forest conditions produce lower values in understory biomass (pounds per acre). Under Alternative 1, understory biomass would continue to decline over the next 40 years. Limited cover around tanks and riparian areas as well as the limited herbaceous understory across the project area, would continue to reduce the likelihood that cuckoos would successfully locate and nest in these areas.

Determination of Effect

Alternative 1 **may affect and is likely to adversely affect** the western yellow-billed cuckoo and its proposed critical habitat.

Alternative 2 – Modified Proposed Action

Prescribed fire and mechanical thinning projects have occurred and are expected to continue in habitat used by western yellow-billed cuckoo on national forests where cuckoos occur. Therefore, proposed fire and non-fire treatments may directly and indirectly affect cuckoos by removing suitable habitat and displacing breeding or foraging birds, and/or by disturbing cuckoos where suitable habitat is not displaced, but within the vicinity of project activities.

These kinds of projects could have short-term adverse effects on western yellow-billed cuckoo habitat by reducing cover, affecting water quality, and reducing prey abundance. Implementation of proposed activities and associated fire and smoke can alter cuckoo behavior by creating visual, noise, and physiological disturbance. Yellow-billed cuckoos may exhibit avoidance, ranging from less than a day where visual and noise disturbance is temporary to more than one breeding season where breeding and foraging habitat have been removed. If cuckoos are present at the time of thinning or prescribed burning activities, individuals could abandon their roosting and nesting sites.

If nests are abandoned, young or eggs would be lost. Any individuals present in or adjacent to treated areas could also experience effects from the loss of prey availability, fire, and visual, noise, and smoke disturbance. The effects could range from habitat use changes, activity pattern changes, increased stress responses, decreased foraging efficiency and success, reduced reproductive success, increased predation risk, and intraspecific diminished communication (NoiseQuest n.d. [2012]; Pater et al. 2009). These responses could vary depending on the nature of the disturbance, but would be expected to decrease as the distance from the activity increases.

Although design features are included in this alternative to mitigate effects from treatments, adverse effects on cuckoos and habitat are still likely to occur during migration and the early part of the breeding season. Prescribed burning just prior to arrival would reduce the available foraging habitat and prey species to cuckoos. Cuckoo home ranges are large, usually at least 50 acres in size. As such, effects on cuckoos and habitat from thinning and prescribed fire might occur within cuckoo riparian breeding habitat and adjacent foraging habitat up to 0.5 mile away.

Prescribed fire, and to a lesser extent mechanical thinning, would also benefit cuckoos by maintaining long-term ecosystem function on these fire-adapted landscapes. Thinning and fire would promote seral stage diversity and reduce fuel build-up that might otherwise result in a stand-replacing, high-severity fire. The regenerating and resprouting trees, shrubs, and herbaceous vegetation resulting from fire would increase the insect production needed by cuckoos to raise young.

Prescribed burning would occasionally use riparian drainages as control lines where no natural physical barriers, roads, trails, or openings can be used. Design features described above would ensure that effects on riparian habitat would be spread across the landscape and temporally separated. In this way, there would never be a case over the lifespan of the project that a single riparian drainage would be treated along its entire length.

Cumulative Effects from Alternative 2

The area analyzed for cumulative effects for Yellow-billed Cuckoo is within the project area's riparian corridors and a 0.5-mile buffer. The temporal boundary is 30 years, including 20 years of implementation and 10 years of riparian system benefits from those treatments. Watershed health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves National Forests), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating cuckoo habitat in Rim Country would be reduced in the short and long terms.

All riparian treatments in cuckoo habitat would coordinate with wildlife biologists to determine timing restrictions, and mitigations cumulatively preventing treatments during the breeding season.

Given the various stages of planning and implementation, most project effects would be dispersed both spatially and temporally. Projects in riparian habitat are typically designed to improve habitat, or to reduce fuel loading and risk of crown fire while retaining habitat function, resulting in a decrease in risk of high-severity fire. Cumulatively there could be increased disturbance to individual cuckoos from noise or smoke in the short term. Given restoration project objectives, the scale of the cumulative effects area and the length of time over which treatments would be implemented (20 years of implementation and ten more years of obtained benefits through reduction of wildfire risk), cumulatively alternative 2 is not expected to negatively affect the cuckoo population in the long term. Cumulatively, treatments in riparian habitat should move forest conditions toward desired conditions and decrease the risk of habitat loss to large-scale high-severity fire.

Climate change, in combination with drought cycles, is likely to exacerbate existing threats to the western yellow-billed cuckoo's habitat in the southwestern United States, now and into the foreseeable future. Implementation of restoration projects such as Rim Country should cumulatively mitigate some of the long-term effects from climate change on western yellow-billed cuckoo habitat.

Determination of Effect

Implementation of Alternative 2 **May affect, is Likely to Adversely Affect** the Yellow-billed Cuckoo and its proposed Critical Habitat.

Alternative 3 – Focused Alternative

Direct and indirect effects for Alternative 3 would be the same as with Alternative 2. Alternative 3 includes the same number of miles and acres of riparian restoration, while reducing the total number of forested acres thinned and treated with prescribed burning. Alternative 3 would treat fewer acres in Rim Country. Project design features have been developed (included in Alternative 2 analysis for the Western yellow-billed cuckoo above) to reduce the potential of effects on nesting and foraging cuckoo habitat.

Cumulative Effects

Same as Alternative 2. Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less watershed restoration.

Determination of Effect

Implementation of Alternative 3 **May affect, is Likely to Adversely Affect** the Yellow-billed Cuckoo and its proposed Critical Habitat.

Mexican Grey Wolf

Alternative 1 – No Action

Under Alternative 1, habitat conditions for wildlife would largely remain in their current condition. Thinning and prescribed fire would still occur as a result of current and reasonably foreseeable projects. However, the landscape would continue to move away from desired conditions (see Affected Environment above and in the Silviculture and Fire Ecology and Air Quality Reports). Alternative 1 would have no direct effect on Mexican wolves. Dense forest conditions would still occur and the high fire hazard potential would persist. Large crown fires could adversely affect potential habitat by destroying understory and overstory vegetation.

Under Alternative 1, there would be no restoration of springs and riparian areas. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (see Water and Riparian Resource Report), resulting in degradation of conditions for potential prey species.

Determination of Effect

Alternative 1 would have **No Effect** to the Mexican wolf.

Alternative 2 – Modified Proposed Action

The 4FRI Rim Country Project lies within the Blue Range Wolf Recovery Area where Mexican wolf denning has not occurred. The Mexican wolf has not been reported denning in or near the Rim Country project area, though dispersing adults have moved through the area and could potentially den in the project area in the future.

If conflicts occur, the Forest Service would work with the Mexican Wolf Field Team to arrive at a solution. Actions taken on the other Ranger Districts where wolves occur included placing temporary restrictions around a wolf den site.

Dispersing reintroduced Mexican wolves might be disturbed during implementation of thinning and prescribed fire. Due to the mobility of the species, reintroduced wolves are likely able to avoid areas receiving treatment. Direct effects from thinning operations would not be expected to affect denning wolves because of the added design feature to limit disturbance.

Thinning and management-ignited fire alters prey species habitat to various degrees. Especially in areas that sustain low to moderate-intensity burns, there would be an eventual, relatively short-term increase in forage and browse used by some prey species.

Cumulative Effects

The cumulative effects analysis area for the wolf is the project area and a 10-mile buffer outside of the project boundary to include dispersing animals. The temporal boundary is 25 years to include 20 years of implementation, and 5 years of effects following treatments. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

Determination of Effect

Potential effects on the Mexican wolf reintroduction project from the Rim Country Project have been analyzed and found to be insignificant and discountable. Wolves have long endured in fire-adapted ecosystems and the implementation of this alternative would not adversely affect the reintroduction effort. Communication with the Interagency Field Team would allow project managers to avoid treatment in close proximity to dens, or during the wolf denning season.

By definition, a non-essential experimental population is not crucial to the continued existence of the species. Therefore, no management activities associated with the Rim Country Project would affect this 10(j) population so designated that could lead to a jeopardy determination for the entire species. The management activities associated with the Rim Country Project in the 10(j) area with Mexican wolves are **not likely to jeopardize the continued existence of the Mexican wolf.**

Alternative 3 – Focused Alternative

The direct and indirect effects from Alternative 3 would be similar to those from Alternative 2. Alternative 3 includes the same number of miles and acres of riparian restoration, while reducing the total number of acres thinned and treated with prescribed burning. Alternative 3 treat fewer acres in the Rim Country project area. A design feature was included (see Alternative 2 analysis above) to reduce the potential of effects on denning wolves.

Cumulative Effects

Same as Alternative 2. Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less forest restoration and providing less risk of severe wildfire effects.

Determination of Effect

Implementation of Alternative 3 is **not likely to jeopardize the continued existence of the Mexican wolf.**

Forest Service Sensitive Species

Northern Goshawk

Alternative 1 – No Action

Vegetation Changes

Under the no action alternative, most of the overall landscape would move toward desired conditions more slowly than the other alternatives, while some areas may not move toward desired conditions at all (Table 77). Post-fledging family areas (PFAs and lands outside PFAs (LOPFAs) would have less age-class diversity than either of the action alternatives.

Table 77. Habitat variables in PFAs by alternative by decade

PFAs	Existing Condition	No Action 2029	No Action 2049	Alt2 2029	Alt 2 2049	Alt 3 2029	Alt3 2049
Avg of Trees per Acre	1062.52	958.87	778.86	450.22	162.39	620.50	379.60
Avg of Basal Area	130.53	137.53	145.49	70.36	57.96	94.55	92.65
Avg of Stand Density Index	303.15	311.01	313.76	154.85	106.20	209.68	185.61
Avg of Quadratic Mean Diameter in Inches	6.01	6.51	7.37	6.55	10.82	6.62	9.74
Avg of SNAG 12-18	1.75	3.08	4.70	6.53	4.09	4.75	3.95
Avg of SNAG 18-24	0.65	0.96	1.54	2.04	1.80	1.51	1.60
Avg of SNAG ≥ 24	0.35	0.38	0.56	1.06	1.07	0.78	0.83
Avg of Canopy Cover %	43.82	45.76	47.56	23.79	18.35	32.17	30.32
Avg of Surface Fuel tons per acre	14.83	16.88	22.06	9.87	9.77	11.95	13.40
Avg of Coarse Woody Debris	4.38	5.06	8.21	4.17	5.15	4.37	5.73
Avg of Downed Logs ≥12”	0.78	1.09	2.47	1.69	2.94	1.44	2.57
Avg of Herbaceous tons per acre	0.21	0.20	0.20	0.25	0.26	0.23	0.23
Average of Shrubs tons per acre	0.31	0.31	0.31	0.37	0.31	0.35	0.31
Avg of ALL BA1 0-1”	0.76	0.61	0.43	0.44	0.09	0.47	0.18
Avg of ALL BA2 1-5”	12.05	13.55	15.17	3.49	2.62	7.24	7.52
Avg of ALL BA3 5-12”	43.09	42.56	41.89	16.35	8.82	26.37	22.63
Avg of ALL BA4 12-18”	39.35	41.76	42.65	21.82	16.10	29.02	26.83
Avg of ALL BA5 18-24”	19.82	22.39	26.31	15.24	15.77	17.51	19.46
Avg of ALL BA6 24” +	15.45	16.67	19.02	13.02	14.55	13.94	16.03

Specifically, it would have the lowest proportion in grass-forb-shrubs, seedlings, and saplings; the highest proportion in mid-aged forest; and the lowest proportion in the older age classes.

Post-fledging Family Areas (PFAs)
In PFAs the FVS modeling of the effects of treatments on northern goshawk by alternative shows that the average trees per acre would remain high under Alternative 1, from the existing 1,062 to 958 in 2029 and 778 in 2049. The average of all basal area and canopy cover would continue to increase slightly, while the stand density index would remain high, from the existing 303 to 313 after 30 years. High competition for resources would keep the quadratic mean diameter low, from the current six inches to seven inches after 30 years. Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would continue to dominate the landscape and represent a huge shift in the NRV for the forested ecosystem.

Snags of all size classes important to prey species would continue to increase very slightly. Coarse woody debris and downed logs important to prey species would increase over 30 years. Herbaceous and shrub layers would show no improvement over time under Alternative 1.

Fuel loads in average of tons per acre would increase from 15 tons per acre in the existing condition to 22 tons per acre after 40 years under Alternative 1. The fire hazard index was modeled in PFAs under existing conditions (Table 79). Of the 39,478 acres modeled, Alternative 1 would result in 31,877acres (81 percent) of the PFAs that could potentially experience high-severity wildfire (Table 79).

The risk of crown fire was modeled in PFAs based on the existing condition. Alternative 1 would result in 34,730 acres (88 percent) of PFAs in the Rim Country project area experiencing crown fire (Table 80).

Lands outside of PFAs (LOPFAs)
The three forest plans have guidance to manage toward uneven-age stand conditions. In LOPFAs, Alternative 1 would have the slowest progress of all alternatives toward having age classes in uneven-aged (desired) condition.

In LOPFAs, FVS modeling of effects on Northern Goshawk by alternative shows that the average trees per acre would remain high under Alternative 1, from the current 1,062 to 964 in 2029 and 783 in 2049. The average of all basal area and canopy cover would continue to increase slightly, while the stand density index would remain high, from 303 to 313 after 30 years. High competition for resources would keep the quadratic mean diameter low, from the existing six inches to seven inches after 30 years. Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would continue to dominate the landscape and represent a huge shift in the Natural Range of Variation of the forested ecosystem.

Snags of all size classes important to prey species would continue to increase very slightly. Coarse woody debris and downed logs important to prey species would increase over 30 years. Herbaceous and shrub layers would show no improvement over time under Alternative 1. Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under Alternative 1. Crown fire potential in ponderosa pine habitat from Alternative 1 could occur in 480,996 acres (87 percent) of this habitat type.

Determination of Effect
Alternative 1 may affect individual goshawks, but is not likely to cause a trend toward federal listing or loss of viability.

Effects Common to Both Action Alternatives

Gambel oak, juniper and pinyon species greater than five inches in diameter at the root collar (diameter root collar) may be considered as residual trees in the target group spacing and stocking.

Manage for large oaks (10 inch diameter at the root collar or larger) by removing ponderosa pine up to 18 inches in diameter that do not meet the “old tree” definition and do not have interlocking crown with oaks and occur within 30 feet of base of oak 10 inches in diameter at the root collar or larger.

Mechanical Treatments

Habitat features that appear to be important to a variety of goshawk prey species would be retained or improved with Alternatives 2 and 3.These habitat features include snags, downed logs, large trees, openings and associated herbaceous and shrubby vegetation, interspersion, and canopy cover (Reynolds et al. 1992, USDI FWS 1998, Squires and Kennedy 2006).

Noise disturbance from logging trucks was monitored for nesting goshawks in a study on the Apache-Sitgreaves National Forests. The study was coordinated between the Apache-Sitgreaves National Forests, Rocky Mountain Research Station, U.S. Army, and a private sound consultant. Results from this field-based, controlled experiment found no evidence of negative effects from truck noise. Observed goshawk response to logging truck noise was limited to, at most, looking in the direction of the hauling road (Grubb et al. 2012).

Disturbance from hauling would vary based on which nest site is selected during the time that hauling occurs. Therefore, road disturbance, even with thousands of truck trips, may cause little or no disturbance.

Road work and use of haul roads could increase the potential for goshawk collision with vehicles. Little information is available on how frequently collisions might occur and what conditions might increase or lessen the vulnerability of goshawks.

A speed limit of 25 miles per hour would be implemented for vehicles passing through PFAs to reduce the hazard of collisions. Given the adult goshawk’s natural agility in flight and the size and noise of the large trucks and chip vans, adult goshawks would be expected to avoid colliding with log trucks passing through the PFA. Newly fledged goshawks still developing their flight skills may have a slightly higher potential for colliding with a large truck, but the reduced speed of the trucks and natural agility of goshawks should minimize this potential. Birds migrating or dispersing through unfamiliar terrain may be at higher risk than resident birds.

Vehicle activity would alternate throughout the Rim Country landscape as different contracts are issued and would concentrate in particular areas while the work is being conducted. Activity would be expected to increase well above existing traffic levels for about two years until operations shift to other areas.

In summary, hauling of wood products or road gravel would be unlikely to cause noise disturbance to nesting goshawks or result in collisions, but there is the potential to disrupt reproduction and rearing of young by, at most, one or two pair of goshawks and might result in the injury or death of one or more young. This risk would be lowered with a lower speed limit.

Prescribed Fire

The forest plans allow for wildfire to occur within PFAs during and outside the breeding season, although human disturbance should be limited during the breeding season so that goshawk reproductive success is not affected by human activities. Low-intensity ground fires are allowed at any time, but high-intensity crown fires are not acceptable in PFAs or nest areas.

The effects from burning would be influenced by the life history of the goshawk at the time of the fire, as well as several fire-related factors including pre-fire fuel loading and structure, the season when the fire occurs, fire intensity, and fuel consumption.. Burning effects would also be related to how similar burning conditions are to the natural fire regime. Knapp et al (2009) provide a good overview of the ecological effects of prescribed fire season.

Goshawks and their prey could be directly affected by the heat, flames, and smoke of a fire or indirectly by habitat modification. Animals that live in fire-adapted ponderosa pine forests have presumably developed behavioral adaptations to escape fires or find refugia and allow populations to persist (Knapp et al 2009).

Incubating adults or young goshawks unable to fly could inhale smoke from prescribed fires. Smoke could result in an extended absence of the adults during brooding or when the chicks are very young. This could result in increased vulnerability to predators or to unfavorable weather, or reduced feeding. Smoke is likely to be worse during first-entry burning, under conditions where fuels have built up to unnatural levels due to years of fire suppression. Smoke would be expected to be more within the range of natural variation after a first-entry burn and to have less intensity or duration. There would be a low likelihood of loss of nest trees or goshawks due to the heat, flames, or smoke of a prescribed fire with the design features for this project.

Wildfire Modeling

Fire hazard index was modeled for one treatment and two prescribed burns in 39,488 acres of PFAs within the project area. Fire hazard index by alternative is in the Table 78 below. The highest and greatest hazard categories of fire hazard index were calculated with percentages of the total habitat type in the project area for further analysis by alternative. 553,120 acres of ponderosa pine habitat type was also modeled for wildfire effects.

Table 78. Fire hazard index in PFA habitat by alternative

Fire Hazard Index	Existing	Alternative 1	Alternative 2	Alternative 3
PFA	27,414 (69%)	31,877 (81%)	10,261 (26%)	18,075 (46%)
PFAs with the Highest and Greatest Hazard Categories	13,511 (34%)	16,056 (41%)	1,968 (05%)	5,106 (13%)
Ponderosa Pine Habitat Type FHI	327,867 (59%)	407,189 (74%)	129,762 (23%)	247,350 (45%)

The potential for crown fire was also modeled in PFAs and ponderosa pine habitat type in the project area by alternative with acres and percentages included in Table 79 below. For further analysis active crown fire was assessed as well in both habitat types.

Table 79. Crown fire assessment in PFAs by alternative

Fire Hazard Index	Existing	Alternative 1	Alternative 2	Alternative 3
PFA All Crown Fire	32,695 (83%)	34,730 (88%)	30,732 (78%)	31,771 (80%)
PFA Active Crown Fire	13,033 (33%)	15,626 (40%)	1,583 (04%)	4,584 (12%)
PP Habitat Type All Crown Fire	430,771 (78%)	480,996 (87%)	447,738 (81%)	471,447 (85%)
PP Active Crown Fire Potential	112,496 (20%)	160,879 (29%)	12,486 (2%)	45,680 (08%)

Alternative 2 – Modified Proposed Action

PFAs

Vegetation Changes

FVS Modeling of Alternative 2 treatments on 37,860 acres of PFAs in the project area would take trees per acre from 1,062 to 450 in 2029 and 162 in 2049. The stand density index would be greatly reduced, from the existing 303 to 106 after 30 years. The quadratic mean diameter would increase from six inches to 10.7 inches after 30 years. Mid-aged forest (BA3, 5 to 12 inches, and BA4, 12 to 18 inches) would be treated to attain the desired condition, reducing these size classes to better represent uneven-aged management. Snags of all size classes important to prey species would continue to increase. Coarse woody debris and downed logs important to prey species would increase over 30 years. Also important to goshawk prey species, herbaceous and shrub layers would increase over time under Alternative 2.

Lands Outside of PFAs (LOPFA)

In LOPFAs the FVS modeling on 902,064 acres of ponderosa pine habitat shows that the average trees per acre would be lowered from 1,069 to 783 in 2029 and 451 in 2049. The average of all basal area and canopy cover would decrease, but the stand density index would be most reduced under Alternative 2, from 303 to 106 after 30 years. Lower competition for resources would increase the quadratic mean diameter, from six inches to nearly 11 inches after 30 years. Mid-aged forest (BA3, 5 to 12 inches, and BA4, 12 to 18 inches) would be greatly reduced under Alternative 2, bringing the age class distribution to desired condition after 30 years.

Snags of all size classes important to prey species would continue to increase from existing conditions. Coarse woody debris and downed logs important to prey species would increase over 30 years modeled. Herbaceous and shrub layers, also important for prey species, would be increased or maintained under Alternative 2.

Fire Effects

In both PFAs and in ponderosa pine habitat fuel loads in average of tons per acre would increase from 15 tons per acre in the existing condition to less than 10 tons per acre after 30 years under Alternative 2.

Fire hazard index was modeled in PFAs for Alternative 2 (Table 78). Of the 39,488 acres modeled Alternative 2 would result in a reduction over the existing condition from 27,414 (69 percent) of all PFA acres in the project area to 10,261 acres (26 percent) that could experience high-severity wildfire.

Risk of crown fire was modeled in PFAs for Alternative 2 (Table 79). Alternative 2 would result in 30,732 acres (78 percent) of PFAs in the Rim Country project area with the potential to experience crown fire. Active crown fire is reduced from 15,626 acres (40 percent) in alternative 1 to 1,583 (4 percent) acres that would experience active crowning under Alternative 2.

Determination of Effect
Considering direct, indirect, and cumulative effects, implementation of Alternative 2 may affect individual goshawks, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

PFA

Vegetation Changes
Alternative 3 would change trees per acre from the existing 1,062 to 620 in 2029 and 379 in 2049. The stand density index would be highly reduced, from 303 to 185 after 30 years. The quadratic mean diameter would increase, from six inches to nearly 10 inches after 30 years. Mid-aged forest (BA3, 5 to 12 inches, and BA4, 12 to 18 inches) would be lowered, though not to the desired conditions. Snags of all size classes important to prey species would continue to increase. Coarse woody debris and downed logs important to prey species would increase over 30 years. Herbaceous and shrub layers would be maintained over time under Alternative 3.

Lands Outside of PFAs (LOPFA)
In LOPFAs, FVS modeling shows that the average trees per acre would be lowered under Alternative 3, from the existing 1,069 to 384 in 2049. The average of all basal area and canopy cover would decrease, but the stand density index would be reduced from 303 to 186 after 30 years. Lower competition for resources would increase the quadratic mean diameter, from six inches to nearly 10 inches after 30 years. Mid-aged forest (BA3, 5 to 12 inches, and BA4, 12 to 18 inches) would be greatly reduced under Alternative 3, bringing these age classes closer to desired conditions after 30 years.

Snags of all size classes important to prey species would continue to increase. Coarse woody debris and downed logs important to prey species would increase over 30 years. Herbaceous and shrub layers, also important for prey species, would be increased or maintained under Alternative 3.

Fire Effects
In both PFAs and in ponderosa pine habitat fuel loads in average of tons per acre increase from 15 tons per acre in the existing condition to less than 13 tons per acre after 40 years under Alternative 3.

Fire hazard index was modeled in PFAs for Alternative 3 (Table 79 above). Of the 39,488 acres modeled Alternative 3 would result in a reduction over the existing condition from 27,414 (69 percent) of all PFA acres in the project area to 18,075 acres (46 percent) that could experience high-severity wildfire.

Risk of Crown Fire was modeled in PFAs for alternative 3 (Table 79 above). Alternative 3 would result in 31,771 acres (80 percent) of PFAs in the Rim Country project area with the potential to experience crown fire. Active crown fire is reduced from 15,626 acres (40 percent) in Alternative 1 to 4,584 acres (12 percent) that would experience active crowning under Alternative 3.

Determination of Effect
Considering direct, indirect, and cumulative effects, implementation of Alternative 3 may affect individual goshawks, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects for alternatives 2 and 3
The cumulative effects analysis boundary is defined as the project area and a one-half mile buffer around the outside of the project boundary, and includes effects for a period of 25 years beginning with implementation of the Rim Country Project... The fire hazard would increase over time as vegetation would continue to grow, fuels continue to accumulate, and the effects from climate change persist.

For Alternatives 2 and 3, the majority of acreage identified as part of the cumulative effects analysis occurs in LOPFA habitat, and the majority of past, current, and foreseeable future treatment acres are prescribed fire only. Most of the proposed treatments in alternatives 2 and 3are mechanical thinning with prescribed fire with alternative 2 cumulatively treating more acres whereas Alternative 3 would have the fewer

Cumulatively, restoration treatments would contribute toward improving forest health, vegetation diversity, and vegetation composition in goshawk habitat under Alternatives 2 and 3. This would aid in sustaining old forest structure over time and moving forest structure toward desired conditions, although on more acres in alternative 2 than in alternative 3. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

The combination of thinning and burning with other projects should improve species richness in the herbaceous understory, increase plant abundance, and improve fruit and seed production.

Treating within current and reasonably foreseeable projects when added to treatments in Rim Country would reduce fire threat for goshawk habitat within the respective project area as well as reducing the threat of high-severity fire starting in these areas and burning habitat outside the areas. In addition, cumulative improvements to understory vegetation and prey habitat are expected to occur in goshawk habitat and be more persistent in the long term compared to more conservative treatments in MSO habitat that are employed because MSOs have different habitat requirements than goshawks.

Cumulative effects from reasonably foreseeable projects could include disturbance from noise and potentially from smoke but could collectively improve goshawk habitat, including PFAs, because the risk of high-severity fire eliminating goshawk habitat would be reduced in the short term and long term. Although smoke and noise can cross project boundaries, both largely disperse with distance. However, some areas where smoke settles could have longer duration short term effects. Other projects, such as the CC Cragin and Beaver Creek Watershed Protection and Fuels Reduction Projects could cumulatively increase effects on goshawks in PFAs adjacent to shared boundaries.

Many current and reasonably foreseeable projects would overlap temporally. It is conceivable that actions would be occurring in PFAs in multiple locations within the 4FRI boundary. However, all or most PFA mechanical treatments or activities would have timing restrictions, postponing treatments until after the breeding season. Wild fire could occur at any time. Adult goshawks would be expected to adapt to fire because it inhabits ponderosa pine, which is a fire-adapted vegetation type in the southwest.

Given the various stages of planning or implementation, most project effects would be dispersed both spatially and temporally. Projects in goshawk habitat are typically designed to improve habitat, or to degrade elements of habitat structure while retaining habitat function, resulting in a decrease in risk of high-severity fire. Cumulative effects would likely increase disturbance to individual goshawks from noise or smoke in the short term., and effects are not expected to affect fecundity because of timing restrictions. Given typical project objectives, the spatial scale of the cumulative effects area, the distribution of goshawk habitat across the project area, and the length of time over which treatments would be implemented (10 or more years), cumulative effects are not expected to negatively affect the goshawk population in the long term. Overall, treatments in goshawk habitat should move forest conditions in the cumulative effects area toward desired conditions and decrease the risk of habitat loss to large-scale high-severity fire.

Northern Leopard Frog

Alternative 1 – No Action

Under Alternative 1, habitat conditions for northern leopard frogs would largely remain in their current condition. Thinning and prescribed fire would still occur as a result of current and reasonably foreseeable projects. However, the landscape would continue to move away from desired conditions. Alternative 1 would have no direct effects on northern leopard frogs; however, there would be substantial indirect effects. Dense forest conditions would still occur and the high fire hazard potential would persist. Large crown wildfires could adversely affect potential habitat by destroying understory and overstory vegetation. As a result, overland flow would increase and soil erosion would increase, with the potential for high sediment loads. Water quality and riparian conditions would be adversely affected on a wide-scale basis, resulting in indirect adverse effects.

Under Alternative 1, there would be no restoration of springs and riparian areas. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future, resulting in degradation of potential habitat for frogs.

Denser forest conditions produce lower values in understory biomass (pounds per acre). Under Alternative 1, understory biomass would continue to decline over the next 40 years. Limited cover around tanks and riparian areas, as well as the limited herbaceous understory across the project area, would continue to reduce the likelihood that frogs would successfully disperse and feed while traveling between waters. The limited cover would also leave frogs vulnerable to predation.

Determination of Effect

Alternative 1 would have no effect on Northern leopard frogs.

Alternative 2 – Modified Proposed Action

Dispersing leopard frogs could be directly affected if they collide with mechanical equipment or if they could not find refugia during prescribed fire activities. All springs and riparian reaches would be surveyed prior to restoration activities. Design features would reduce the likelihood of direct effects on frogs from mechanical thinning, temporary road construction, spring and riparian restoration, road decommissioning, and prescribed fire.

Under the modified Proposed Action, dense forest conditions and surface fuel loading would be reduced. The likelihood of large crown wildfires adversely affecting potential habitat by destroying understory and overstory vegetation would be reduced from 327,867 acres (59 percent) of all ponderosa pine in the project area, to 129,762 acres (23 percent) from Alternative 2. Fire hazard index in grasslands would also be greatly reduced from treatments (from 5,000 acres in the existing condition to 138 acres in Alternative 2). As a result, overland flow would be stable, and soil erosion would not have the high sediment-loading potential. Water quality would be not adversely affected on a wide-scale basis, resulting in indirect beneficial effects.

Under Alternatives 2 and 3, springs, meadows, and aquatic habitat restoration would be implemented, benefiting NLFs. There would be short-term disturbance to vegetation during implementation of stream and spring restoration projects; however, restored vegetation would be expected to recover within one to three years. An important consideration for restoration of springs is to restore discharge from the spring source except where prescribed by existing water rights adjudicated. Alternatives 2 and 3 would allow discharge from springs to resume flow through their historic spheres of discharge. Spring and seep restoration would improve riparian vegetation increasing availability of food and reproductive sites for this species over the long term, resulting in direct beneficial effects on habitat. Restoration of aquatic habitats would improve cover and water flow that provides escape from predators and prevents water loss for migrating leopard frogs.

Reconstructing 40 miles of temporary roads along their original alignments would generally have limited effects on the physical habitat features along the roads. About 30 miles of road reconstruction would address safety concerns for hauling. The remaining miles (about 10) would relocate roads out of drainage bottoms. Relocated roads would include rehabilitation of the abandoned road segment. Disturbance associated with road traffic is not expected to change because this represents improvements to segments of existing road, not new road construction. If each mile affects approximately three acres of habitat, then about 120 acres of breeding and dispersal habitat would be affected by road reconstruction.

Constructing temporary roads would disturb vegetation and reduce habitat quality for leopard frogs. Use of these roads by machinery and equipment could crush animals moving across the road. These effects may affect individuals but are expected to be short-term, occurring only during project implementation. Temporary roads would be decommissioned to eliminate use and vegetation would be restored over the long term.

Decommissioning roads would improve the quality of the habitat in those areas where the roads are decommissioned. While the physical structure and features of the habitat may not measurably change along the former road alignment, eliminating disturbance along the roadway would be expected to improve the quality of habitat and reduce the potential for frogs to be crushed by vehicles using these roads.

Implementation of the modified proposed action could increase the risk of spread of chytrid fungus across the project area. Machinery and equipment used during implementation could transfer chytrid fungus between waterbodies, increasing the occurrence of the pathogen in leopard frog habitats across the project area. Potential effects from chytrid fungus that is spread by machinery and equipment would be minimized by requiring decontamination procedures to be followed when activities take place within wetted areas or moist perimeter of a tank or ephemeral stream (see design features). Therefore, minimal potential for spread would exist.

Under the modified proposed action, surface disturbance within proximity of suitable habitats would increase. Direct effects could result from crushing and trampling of migrating or basking individuals. The use of heavy machinery and increased levels of human activity and traffic are likely to increase sedimentation in the earthen livestock tanks in the vicinity, especially in those located downslope from treated areas. Effects from sedimentation on leopard frog habitats are extensive and varied. They include alterations in water quality and vegetation structure, that ultimately have detrimental effects on leopard frogs by decreasing rate of development, increasing vulnerability to predators, and reducing food availability.

Prescribed burning may result in mortality of leopard frogs. Early fall prescribed fire has the highest likelihood of affecting leopard frogs, as this is a time of year when they are migrating between suitable habitats. Leopard frogs may migrate en masse, and large numbers may therefore be susceptible to fire at one time. Prescribed burns would be coordinated with a wildlife biologist to insure protections for migrating frogs. In coordination with AZGFD, occupied and potential breeding sites have been identified and mapped and would be included in individual contract maps with a special water designation. Project design features have been developed to reduce the potential effects on these important breeding sites and frogs using and moving between these sites (see Appendix 5 in the Wildlife Specialist Report). Implementation of best management practices would curtail soil erosion and minimize the potential for inflow into potential northern leopard frog habitat.

Determination of Effect

Implementation of Alternative 2 may affect individual northern leopard frogs, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

Alternative 3 treats fewer forest acres in Rim Country, but the direct and indirect effects would be similar to Alternative 2. Alternative 3 includes the same miles and acres of riparian and other habitat restoration, while reducing the total number of acres thinned and treated with prescribed burning. While short-term effects from disturbance would be slightly less in Alternative 3, the long-term effects on the risk of habitat degradation from stand-altering wildfire or insect infestations would be greater.

Determination of Effect

Implementation of Alternative 3 may affect individual northern leopard frogs, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects for alternatives 2 and 3

The cumulative effects analysis area for northern leopard frogs is the project area and a 0.25-mile buffer outside of the project boundary to include current and potential breeding sites. The temporal boundary is 30 years to include the effects of 20 years of implementation with effects from treatments lasting 10 years of riparian benefits following implementation.

The restoration of aquatic habitats included in these alternatives when added to treatments from other projects would slow the combined effects from other forest activities, high-impact recreational use, livestock grazing, habitat loss and degradation on private lands. Implementing restoration of key aquatic and dispersal habitat would link, rather than fragment, these habitats, allowing for the needs of breeding and dispersing leopard frogs. Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less overall watershed restoration and providing less risk of severe wildfire effects than alternative 2.

Bald Eagle

Alternative 1 – No Action

Under Alternative 1, current and reasonably foreseeable projects would still be implemented in the Rim Country project area. Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under Alternative 1. Crown fire potential in ponderosa pine habitat from Alternative 1 could occur in 480,996 acres (87 percent) of this habitat type. Dense forest conditions would still occur across the project area, and the high fire hazard potential would continue to place potential bald eagle nesting, roosting, and foraging habitat at risk with respect to stand-replacing fire.

Tree densities would continue to be high, slowing or stagnating growth into larger diameter classes, thereby limiting the development of roosting and perching habitat. Meadows, grasslands, and savannas would continue to be encroached by trees, limiting potential foraging areas.

Determination of Effect

Because of the design features included for both action alternatives to mitigate disturbance to eagles, Alternative 1 **would not result in take** as defined in the Eagle Act for bald eagles Effects Common to Both Action Alternatives.

Direct effects would be from activities that cause disturbances (smoke, auditory or visual) to bald eagles nesting or foraging within or adjacent to the project area. Under the action alternatives (the modified proposed action and the focused alternative), there would be no direct adverse effects on nesting eagles as project design features would eliminate disturbance near known nesting sites. No vegetation treatments would occur within 0.5 mile (2,500 feet), unless mitigated by topography, of an occupied bald eagle nest between March 1 and August 31. Drift smoke from prescribed fire would be expected. Concentrations of smoke that might settle in an area for more than one or two nights when a female is on the nest could have adverse effects on individuals. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignition sites. Nests on cinder cones and other raised topographic features and in Sycamore and Oak Creek Canyons, or in canyons immediately adjacent to Sycamore and Oak Creek Canyons or the Mogollon Rim, are not expected to have smoke settle in them long enough to cause measurable effects on eagles because of the air movement in these landscape-scale features. Conversely, nests in small canyons or valleys might incur effects from dense smoke settling near nesting locations.

When smoke settles into low-lying areas it typically does not last more than one or two nights. Limited smoke at nest locations would be expected to expose adult eagles to negligible effects as this would repeat an aspect of their evolutionary environment (Horton and Mannan 1988, Prather et al. 2008). However, on occasion dense smoke may settle into specific nest locations. Dense smoke settling into nest areas early in the season (January through June) could disturb brooding females. If the female is flushed long enough to affect incubation, this could result in loss of viability of the eggs. Dense smoke settling for multiple consecutive nights could affect the developing lungs of nestlings. Unlike mammals, damaged avian lungs do not repair themselves through time (Rombout et al. 1991). Triggering a female to discontinue incubating eggs or affecting the lung development of nestlings would constitute long-term adverse effects. Outside of these examples, smoke settling in nest locations would typically be short-term and not likely to cause adverse effects.

Alternatives 2 and 3 would exclude mechanical thinning treatments within a 300-foot buffer around confirmed nest and roost sites. Additionally, timing restrictions during the winter roosting season would provide protection from disturbance to roosting eagles. Potential roost treatments would be designed to maintain and develop roost characteristics such as large trees and snags, while reducing surface fuel loading and crown fire potential within the roost, increasing roosting habitat for eagles in the project area.

There would be no effect on nesting or roosting eagles; however, short-term disturbance to foraging bald eagles would occur during mechanical treatments, prescribed burning, hauling of wood products, and other project activities that may cause visual or auditory disturbance. Prescribed burning and mechanical treatment would occur annually; however, these are short-term effects and would be minimized due to activities being temporally and spatially separated. Prescribed burning effects would dissipate over time as first-entry burns would consume accumulated surface fuels, raising crown bulk height and reducing crown bulk density. In maintenance or second-entry burns in ponderosa pine cover types, fuel loads would be significantly lower and produce low-severity effects with fewer emissions. Disturbances would be localized, of short duration, and might affect individual birds but would not affect the overall distribution or reproduction of the species.

Indirect effects on the bald eagle include effects on eagle habitat, eagle prey species, or prey species habitat. No adverse effects on prey species or prey species habitat are anticipated. Indirect effects on habitat would occur from treatments that modify the number of trees in a group of suitable roost trees, as eagles prefer to roost in large trees in close proximity to each other. However, thinning would improve old tree longevity, resulting in beneficial effects. In RUs with documented bald eagle use, snags would slightly increase after treatment (2020) and continue to increase in the long term. Ignition techniques and site preparation would reduce potential mortality in these components from burning activities.

The modified proposed action (Alternative 2) would develop older larger tree size classes which could be used as future winter roost sites for bald eagles.

Determination of Effect

Because of the design features included for both action alternatives to mitigate disturbance to eagles, Alternatives 2 and 3 **would not result in take** as defined in the Eagle Act for bald eagles.

Cumulative Effects

The cumulative effects analysis area for bald eagles is the ponderosa pine habitat within the project area and a 0.5-mile buffer outside the project boundary. The temporal boundary is 30 years to include the effects of 20 years of implementation with effects from treatments lasting 10 years of riparian benefits following implementation.

Short-term effects added to similar effects from nearby projects were considered. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

Implementation of other project activities could occur simultaneously; however, it is not anticipated that effects from those activities would combine with the effects from the Rim Country Project to produce negative effects. Both action alternatives would improve and develop quality potential nesting and roosting habitat by developing groups of large trees and snags that are more fire resistant. This positive effect would combine with similar effects from activities such as the Travel Management Rule efforts, which may decrease the frequency of disturbance on the majority of potential roost sites, and slightly counteract the effects from utility line and road construction and maintenance as well as short-term disturbances from vegetation management and prescribed fire.

Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less overall watershed restoration and providing less risk of severe wildfire effects than alternative 2.

Golden Eagle

Alternative 1 – No Action

There would be no direct effects on golden eagles as no habitat-altering activities or disturbance associated with project implementation would occur. Alternative 1 would not treat meadows, savannahs, or grasslands within the project area and trees would continue to encroach, reducing potential habitat for small mammals and consequently golden eagles. Tree densities would continue to be high, slowing growth into larger diameter classes and thereby limiting the development of larger diameter (18 inches or larger) trees important for nesting, roosting, and perching. Habitat conditions would remain in their current condition, notwithstanding natural processes. Dense forest conditions would still occur and the high fire hazard potential would continue to place potential golden eagle breeding, nesting, and foraging habitat at risk with respect to stand-replacing fire.

Effects Common to Both Action Alternatives

Both action alternatives would have the same effects on eagles, with Alternative 2 thinning and treating more acres, but with the same potential effects from restoration activities. Direct effects would be from activities that cause disturbances (smoke, auditory, or visual) to golden eagles nesting or foraging within or adjacent to the project. Under the modified proposed action or focused alternative, there would be no direct adverse effects on nesting eagles as project design features would eliminate disturbance near known nesting sites. No vegetation treatments would occur within 0.5 mile (2,500 feet) of an occupied golden eagle nest (unless mitigated by topography) between March 1 and August 31. Drift smoke from prescribed fire would be expected in most places; concentrations of smoke that might settle in an area for more than one or two nights when a female is on the nest could have adverse effects on individuals. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignition sites. Nests on cinder cones and other raised topographic features on the Mogollon Rim are not expected to have smoke settle in them long enough to cause measurable effects on eagles because of the air movement in these landscape-scaled features. Conversely, nests in areas occurring in small canyons or valleys may have dense smoke settle in nesting locations.

When smoke settles into low-lying areas, it typically does not last more than one or two nights. Limited smoke at nest locations would be expected to expose adult eagles to negligible effects as this would repeat an aspect of their evolutionary environment (Horton and Mannan 1988, Prather et al. 2008). However, on occasion dense smoke may settle into specific nest locations. Dense smoke settling into nest areas early in the season (March through June) could disturb brooding females. If the female is flushed long enough to affect incubation, this could result in loss of viability of the eggs. Dense smoke settling for multiple consecutive nights could affect the developing lungs of nestlings. Unlike mammals, damaged avian lungs do not repair themselves through time (Rombout et al. 1991). Causing the female to discontinue incubating eggs or affecting lung development of nestlings would result in long-term adverse effects. Outside of these examples, smoke settling in nest locations would typically be short-term and not likely to cause adverse effects.

Under the modified proposed action, mechanical treatments, prescribed burning, road construction and decommissioning, hauling of wood products, and other restoration activities may cause visual or auditory disturbance to foraging golden eagles. This disturbance would be localized, of short duration and low intensity, and would not be expected to substantially interfere with normal feeding behavior. Up to 40,000 acres of prescribed burning and 45,000 acres of mechanical treatment would occur annually; however, these would be short-term effects and would be minimized due to activities being spatially and temporally separated. Additionally, prescribed burning effects would dissipate over time, as first entry burns usually consume accumulated surface fuels, raising crown bulk height and reducing crown bulk density. In maintenance or second entry burns in ponderosa pine, fuel loads would be significantly lower and produce low-severity effects with fewer emissions.

Indirect effects on the golden eagle include effects on eagle habitat, eagle prey species, or prey species habitat. There are no anticipated adverse effects on prey species or their habitats. Opening the canopy would provide improved visibility of and access to prey by golden eagles. Grassland and savanna treatments would maintain and improve foraging habitat on 36,340 acres of grassland and 17,590 acres of savanna habitat, improving prey species habitat by increasing availability of food for small mammals and resulting in an indirect beneficial effect.

Determination of Effect

Because of the design features included for both action alternatives to mitigate disturbance to eagles, the proposed treatments and activities **would not result in take** as defined in the Eagle Act for golden eagles.

Cumulative Effects

The cumulative effects analysis boundary is defined as the project area and a one-half mile buffer around the outside of the project boundary, and includes effects for a period of 25 years beginning with implementation of the Rim Country Project. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

Other activities planned that may have similar effects include temporary disturbances caused by prescribed fire and thinning in adjacent projects, or effects on roosting habitat from utility infrastructure development and maintenance. These short-term effects added to similar effects from other activities were considered. Implementation of other fuel reduction and restoration activities could occur simultaneously; however, it is not anticipated that effects from those activities would combine with effects from the Rim Country Project to cause negative effects.

Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

American Peregrine Falcon

Alternative 1 – No Action

In grasslands, savannas, and meadows, tree encroachment and surface litter accumulation would continue, continuing to negatively affect some prey habitats for peregrine falcons. Stability of key ecosystem components such as species composition, forest structure, soil characteristics, and hydrologic function would be at moderate to high risk of loss in the event of a disturbance such as a high-severity wildfire. This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative contribution to potential grassland habitat.

Determination of Effect

Under the No Action Alternative, there would be **no direct or indirect effects on peregrines**. There would be no change to the prey species base, and no change in falcon hunting patterns within associated forest structure.

Effects Common to Both Action Alternatives

Constructing and reconstructing roads along their original alignments, including temporary and relocated roads, would not have noticeable effects on the physical habitat features along the roads. Increased disturbance associated with the increased activity on the improved road conditions may decrease the habitat quality along the improved roads. Aquatic and other habitat restoration in Alternatives 2 and 3 would improve habitat. There would be short-term disturbance to vegetation during implementation of restoration projects. However, restored vegetation would be expected within one year following restoration activities.

Decommissioning of roads in Alternatives 2 and 3 would improve the quality of the habitat in those areas where roads are decommissioned. The physical structure and features of habitat for falcons and their prey would be improved along the former road alignment, and disturbance along the roadway would largely be eliminated, thereby improving the quality of habitat in the long term.

Constructing temporary roads would disturb vegetation and reduce available habitat for peregrine prey. This may affect individuals but is expected to be short term, occurring only during project implementation. Temporary roads would be obliterated to eliminate use and vegetation would be restored over the long term.

Alternative 2 – Modified Proposed Action

Under the modified proposed action, no direct effects from mechanical treatments, temporary road construction, prescribed burning, or spring, riparian habitat, and ephemeral stream restoration is expected. There are four peregrine eyries (nest locations) within the project area. All four are associated with one pair of peregrines. These eyries are located on cliff ledges in a rugged canyon. No thinning treatments are proposed in these areas though they often overlook woodlands, riparian areas, or other habitats supporting avian prey species in abundance, which describes most of the Mogollon Rim and Steeper canyons: a burn-only treatment is planned. Smoke from burning operations would be expected to drain away from the nest location, reducing the potential for birds to be exposed to heavy concentrations of smoke. This area is also designated as a Mexican spotted owl protected activity center; protection measures developed for the owl would also protect peregrines breeding in this area as their breeding season overlaps with the owl.

Mechanical treatments prescribed burning, hauling of wood products, and other project activities may cause visual or auditory disturbance to foraging peregrine falcons. Approximately 40,000 acres of prescribed burning and 45,000 acres of mechanical treatment would occur annually; however, these are short-term effects and would be minimized due to activities being temporally and spatially separated. This disturbance would be localized, of short duration and low intensity, and may affect individual birds, but would not affect the overall distribution or reproduction of the species.

While peregrines do not nest or forage in ponderosa pine forest, active management in portions of the pine forest could potentially affect prey base habitat such as meadows, grasslands, and savannas, which are commonly encroached by pine trees as a result of fire exclusion. Restoring these habitats toward historic conditions and increasing water yield across the forest to improve marsh, pond, or lake habitat could increase prey base for peregrine falcons, resulting in an indirect beneficial effect.

Determination of Effect

Alternative 2 may affect individual peregrine falcons, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

Alternative 3 treats fewer forest acres in Rim Country. The direct and indirect effects would be similar to Alternative 2. Alternative 3 includes the same miles and acres of riparian and other habitat restoration, while reducing the total number of acres thinned and treated with prescribed burning. While short term effects from disturbance would be lessened slightly in Alternative 3, long term effects of risk of habitat degradation from stand-altering wildfire or insect infestations are greater.

Determination of Effect

Alternative 3 may affect individual peregrine falcons, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for peregrine falcons is grassland, savanna, and riparian habitat within the project area and within 0.5 mile outside the project boundary. The temporal boundary is 30 years to include the effects of 20 years of implementation with effects from treatments lasting 10 years of riparian benefits following implementation.

Under both action alternatives, there would be an additive indirect effect from activities that modify vegetation. Those projects where thinning and burning are implemented could affect the prey base on a short-term basis by affecting individuals of prey species, by disturbing or harming prey species' habitat with fire. However, projects would be implemented at different times and in different locations, cumulatively minimizing disturbances to the prey base.

Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

Other past, present, and ongoing projects have implemented thinning and prescribed burning (39,000 acres) in grasslands, which would cumulatively improve habitats for peregrine prey species in the long term.

Western Burrowing Owl

There are no documented nesting burrowing owls on the project area; however, potential nesting habitat does exist.

Alternative 1 – No Action

Tree encroachment and canopy development of existing trees would largely continue under Alternative 1. Denser forest conditions would produce lower values in understory biomass (pounds per acre). Understory biomass would continue to decline over the next 40 years under Alternative 1. This in turn would lead to less available habitat for prairie dogs and, consequently, burrowing owls. Vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects on prairie dog habitat and potential habitat for western burrowing owls. Acres of grassland in Fire Regime Condition Class 1 would decrease in the absence of any type of treatment, as woody species continue to encroach and species composition shifts in favor of less fire-adapted species. Grasslands in the project area are at high risk of losing key ecosystem components such as species composition, forest structure, soil characteristics, and hydrologic function in the event of high-severity fire. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals.

This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative effects on potential western burrowing owl habitat.

Alternative 2 – Modified Proposed Action

Alternative 2 would restore about 54,000 acres of historic grassland and savannahs. Indirect effects on burrowing owls would include effects on owl habitat, owl prey species, or prey species habitat. Active management in some areas of ponderosa pine forest could potentially affect their habitat (for example, meadows and grasslands are commonly encroached by pine trees as a result of fire exclusion). Restoring these habitats toward historic conditions could increase potential nesting and foraging habitat for western burrowing owls.

Meadow restoration treatments would improve and increase available habitat for prairie dogs, which would subsequently provide nesting habitat for burrowing owls. The modified proposed action would increase available habitat for prairie dogs with 54,000 acres of grassland, meadow, and savanna restoration treatments. Grassland treatments would not lead to a change in the percent of area with the potential for crown fire. Prescribed burning would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats for insects and small mammals, increasing food sources and resulting in an indirect beneficial effect for burrowing owls.

Determination of Effect

Alternative 2 would have **no effect** on burrowing owls but would improve potential future habitat for the species. **It is not likely to cause a trend toward federal listing or loss of viability.**

Alternative 3 – Focused Alternative

Direct, indirect, and cumulative effects from Alternative 3 would be the same as those from Alternative 2.

Determination of Effect

Alternative 3 would have no effect to burrowing owls. It is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for burrowing owls encompasses the project area and the associated prairie dog complexes. The temporal boundary is 30 years to include 2o0 years of implementation and 10 years of benefits from treatments.

Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

Cumulative activities such as implementing the Travel Management Rule are likely to decrease motorized use in grasslands, thus decreasing effects on prairie dog populations. This, combined with forest thinning and prescribed burning activities, could open up more habitat and increase grassland habitat connectivity. Short-term and localized effects from mechanical thinning and prescribed burning would result in disturbance, and the potential for collapse of burrows and displacement of prairie dogs. This effect may be cumulative with short-term effects from localized dispersed camping, wildfire, and wildfire suppression activities to temporarily displace prairie dog populations (and potentially burrowing owls) in limited areas.

Thinning 36,340 acres of grassland would cumulatively add to treatment acres from this project to reduce tree densities in grasslands and connect open corridors across the project area, providing additional potential future habitat for burrowing owls. Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Navajo Mogollon Vole

Alternative 1 – No Action

In Alternative 1, grasslands, meadows, and savannahs would not be rehabilitated. At the landscape scale, there would be no benefits to vole habitat. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases. Acres of grassland would decrease in the absence of any type of treatment, as woody species continue to encroach and species composition shifts in favor of less fire-adapted species. Acres of ponderosa pine with the likelihood of high-severity wildfire would continue to increase. Ponderosa pine in the project area would be at a high risk of losing key ecosystem components, should there be a disturbance event such as fire or extended drought (Fire Ecology and Air Quality Report). Ponderosa pine in the project area is at high risk of losing key ecosystem components such as species composition, forest structure, soil characteristics, and hydrologic function in the event of high-severity fire.

Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type in the project area, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under Alternative 1. Crown fire potential in ponderosa pine habitat from Alternative 1 could occur in 480,996 acres (87 percent) of this habitat type, affecting the surrounding grasslands, meadows, and savannahs.

Vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects on vole habitat.

Determination of Effect

Alternative 1 would have no effect on the Navajo Mogollon voles, and is not likely to cause a trend toward federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Under the modified proposed action, thinning and prescribed burning activities might disturb individual voles, resulting in direct adverse effects. Prescribed burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Such activities would occur across the project area at different times; thereby reducing effects on this species. In addition, the effect would be short-term and would have no effect on the population viability of voles. However, fire exclusion has resulted in uncharacteristically dense forests and meadow and grassland encroachment. Forest treatments can indirectly affect potential vole habitat by restoring meadows and reducing uncharacteristic tree densities and patterns in ponderosa pine forest. Restoring meadows and creating openings in the forest would increase potential understory development, including bunch grasses and other plants with C3 photosynthetic pathways, providing preferred food sources for voles.

In addition to grassland, savannah, and meadow restoration treatments, Alternative 2 calls for a diverse range of mechanical treatments where canopy openness would vary from 10 to 90 percent, depending on localized site conditions. Opening the canopy would provide both habitat connectivity and habitat stepping stones, facilitating landscape movements of dispersing voles. Reducing stand density could potentially reverse the declining trend in C3 plants and increase habitat quality for Mogollon voles. Prescribed fire and mechanical treatments would improve the stability of key ecosystem elements such as species composition, forest structure, soils, and hydrologic function. Moving these habitats toward historic conditions could increase potential habitat quality and quantity and reduce the risk of uncharacteristic, high-severity wildfire. The reduction of ponderosa pine basal area, increased growth in the understory vegetation on the forest floor, and increases in snags would result in indirect beneficial effects on the vole.

Under Alternative 2, as many as 250 miles of closed roads could be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting, potentially reducing snags along roadways. Ganey (personal communications 2012) found an inverse relationship between snags and roads, so the proposed decommissioning of roads means more snags would be available in the future within vole habitat.

Fence design would allow access to small mammals. In addition, about 10 miles of road segments would be moved out of drainage bottoms, further enhancing vole habitat.

Determination of Effects

Alternative 2 may affect the Navajo Mogollon vole, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

The effects from this alternative would be similar to those from Alternative 2. The same grassland restoration acres are proposed. Fewer acres are proposed for thinning and burning and 15,000 fewer acres of savannah treatments are proposed.

Determination of Effects

Alternative 3 may affect the Navajo Mogollon vole, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for Navajo Mogollon voles is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Short-term effects added to similar effects from nearby projects were considered. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms. Implementation of other project activities could occur simultaneously; however, it is not anticipated to cause cumulative negative effects. Both action alternatives would move these habitats toward historic conditions and could increase potential habitat quality and quantity, reducing the risk of uncharacteristic, high-severity wildfire. This positive effect, combined with similar effects from activities such as the Travel Management Rule efforts, may decrease the frequency of disturbance on the majority of potential breeding sites, slightly counteracting the effects from utility line and road construction and maintenance, and short-term disturbances from vegetation management and prescribed fire.

Livestock are managed in systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects from their grazing. However, wild ungulates would continue to reduce vegetative understory and affect plant composition. Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands and meadows, thus decreasing effects on vole habitat. This, combined with forest restoration activities, could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving vole populations.

Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects. Western Red Bat

Alternative 1 – No Action

With no treatments for the Rim Country Project, habitat quality would deteriorate for this species as overtopping ponderosa pine would lead to a decline in Gambel oak roosting habitat. The high fire hazard potential would persist, and a large, uncharacteristically severe wildfire event would have the potential to affect individuals. Acres of grassland in Fire Regime Condition Class 1 would decrease in the absence of treatments beyond the 13,440 acres of grassland thinning and burning resulting from current and reasonably foreseeable projects (see cumulative effects to all species section). At the landscape scale, woody species would continue to encroach into openings and species composition would shift in favor of less fire-adapted species. Ponderosa pine cover types in the project area would be at a high risk of losing key ecosystem components, should there be a large-scale disturbance event. In the event of high-severity fire, these key ecosystem components include species composition, forest structure, soil characteristics, and hydrologic function. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals.

Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type in the project area, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under Alternative 1. Crown fire potential in ponderosa pine habitat from Alternative 1 could occur in 480,996 acres (87 percent) of this habitat type, affecting the surrounding grasslands, meadows, and savannahs.

Although habitat would be provided for this species, most of the forested area within the project area is in a moderately closed or closed canopy condition. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in indirect adverse effects. Under Alternative 1, limited acres of grasslands and forest opening would be restored, thus reducing foraging habitat for red bats. Gambel oak would continue to be overtopped by pine. Loss of mid- to large-diameter classes of oak from competition and from crown fire could reduce day roosts for red bats.

Water quality and riparian conditions would be adversely affected on a wide-scale basis, resulting in indirect adverse effects. Under Alternative 1, there would no restoration of springs and no restoration of ephemeral channels. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future, resulting in degradation of potential habitat for western red bats.

Determination of Effect

Alternative 1 may affect western red bats, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Prescribed burning in riparian areas would be coordinated with wildlife biologists to determine presence of federally listed or sensitive species (plants or animals) as well as mitigations needed for rare or sensitive species in/near the work areas. Thinning and prescribed burning activities could potentially disturb red bats if they are roosting in trees and caves, or hibernating among leaf litter within the ponderosa pine treated area. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) could have negative effects on local populations. However, most prescribed burning would occur in the spring and fall, and burn plans within 0.5 mile of known roosts or hibernacula would be designed to limit smoke at critical times (April–July and mid-winter).

Prescribed burning might result in the loss of snags and Gambel oak which could affect roosting bats. However, mitigation including managing for retention of all snags 18 inches in diameter and ignition techniques would reduce the losses of these forest components. Recruitment snags would be provided by retaining trees 18 inches in diameter and greater with dead tops and lightning damage. Selective thinning designed to release oak from competition would help create and retain mid- to large-sized oak. The modified proposed action is expected to result in a slight short-term decrease in snags followed by an increase over the long term. This short-term loss of snags is not expected to affect the overall distribution of western red bats on the forest.

Alternative 2 calls for a diverse range of mechanical treatments that would vary from 10 to 90 percent open depending on site conditions. Prescribed burning after mechanical treatments would result in the removal of cover and food. However, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial effects on bats. Forest conditions after treatment would improve bat habitat within the project area by increasing diversity and the density of understory vegetation, which provides habitat for prey populations, as many invertebrates are tied to specific understory plant species. Indirect benefits could potentially result from restoring meadows encroached by pine trees, and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest that resulted from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit western red bats and their prey. Moving these habitats toward historic conditions would also increase the resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under the modified proposed action, spring, seep, and ephemeral channel restoration would improve riparian vegetation, increasing availability of food for bats over the long term, resulting in indirect beneficial effects.

Determination of Effect

Alternative 2 may affect the western red bat, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

The direct, indirect, and cumulative effects on the Western red bat from Alternative 3 would be the same as from Alternative 2.

Determination of Effect

Alternative 3 may affect the western red bat, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for western red bats is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Short-term disturbance to bats would occur during thinning, hauling, and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term effects added to similar effects from other past, present, and reasonably foreseeable projects were considered. Implementation of other fuel reduction activities could occur simultaneously; however, it is not anticipated that effects from these projects would combine with effects from the Rim Country Project activities to cause a negative effect. Ungulate grazing within the project area would reduce understory vegetation, which would reduce plant availability to adult insects, a primary food source. Generally, grazing systems are managed on a rotation to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However, wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters.

Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects. Pale Townsend's Big-eared bat.

Alternative 1 – No Action

With no treatments for the Rim Country Project, habitat quality would deteriorate for this species as overtopping ponderosa pine would lead to a decline in roosting habitat. As tree densities increase, there would be less edge habitat, thereby reducing foraging opportunities. Seeps and springs would not be restored, which would continue to reduce the availability of riparian-associated host plants for noctuid moths on which the bat preys. High fire severity potential would persist, and a large, uncharacteristically severe wildfire event would have the potential to affect many individuals. Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type in the project area, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under Alternative 1. Crown fire potential in ponderosa pine habitat from Alternative 1 could occur in 480,996 acres (87 percent) of this habitat type, affecting the surrounding grasslands, meadows, and savannahs.

Fire intensity would continue to increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects on bat habitat. Acres of grassland would decrease in the absence of any type of treatment, as woody species continue to encroach and species composition shifts in favor of less fire-adapted species. Ponderosa pine cover types in the project area would be at a high risk of losing key ecosystem components, should there be a disturbance event, such as fire or extended drought (Fire Ecology and Air Quality Report). Key ecosystem components such as species composition, forest structure, soil characteristics and hydrologic function would be at a high risk of loss in the event of high-severity fire. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals. Thirty-nine percent of the ponderosa pine and 12 percent of grassland habitat would support a crown fire. Marginal foraging habitat would still exist for this species; however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals, resulting in indirect adverse effects.

Determination of Effect

Alternative 1 may affect pale Townsend's big-eared bats, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Forest management treatments potentially benefiting bats and their prey include group selection (small groups of trees removed for regeneration of new age classes resulting in a mosaic of roosting habitat, and small to medium gaps for foraging) and single tree selection (individual trees of all size classes removed fairly uniformly). These treatments maintain diverse forest structure and roost trees, create gaps that enhance edge habitat, and provide diverse vegetation structure increasing herbaceous vegetation important for bats' insect prey (Taylor 2006).

There are caves within 300 feet of the project boundary. Coconino Forest Plan guidelines recommend a 300-foot buffer around cave entrances, sinkhole rims and drainages leading to these features. This is a design feature for all known caves within the project area for Alternatives 2 and 3. Design features were added to the project to reduce effects on bat roosts. This would eliminate the potential for damage to the cave from mechanized equipment or increased sedimentation and would eliminate disturbance to Townsend's bats if they are roosting in caves. This would eliminate the potential for damage to the cave from mechanized equipment or increased sedimentation, and would eliminate disturbance to Townsend's bats if they are roosting in caves.

Thinning and prescribed burning activities could potentially disturb Townsend's bats if they are roosting in trees within the ponderosa pine treated area. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning would occur in the spring and fall, and burning within 0.5 mile of known roosts or hibernacula or unsurveyed caves and mine shafts would be designed to limit smoke at critical times (April–May and mid-winter). Prescribed burning could also result in the loss of individual snags/hollow logs, which could affect roosting bats; however, mitigation including managing for retention of all snags 18 inches diameter and greater prior to prescribed burning would reduce the effects. The modified proposed action would be expected to result in a slight short-term increase in snags followed by a continued increase over the long term.

Prescribed burning would result in the removal of cover and food. However, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed burning. These activities would disturb or remove understory vegetation, subsequently reducing availability of insects. These effects would be short-term and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in and at the edges of meadows, restoring meadows, and prescribed burning would encourage the development of understory vegetation, and increase the amount of edge which would increase availability of food for the bat over the long term. Increasing diversity and density of understory vegetation provides habitat for prey populations. Many invertebrates are tied to specific understory plant species (Capinera 2010). Indirect benefits could potentially result from both restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest that resulted from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit pale Townsend's big-eared bats and their prey. Moving these habitats toward historic conditions would also increase the resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under Alternative 2 there are up to 250 miles of closed roads that could be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting potentially reducing snags along roadways. Ganey (personal communications, 2012) found an inverse relationship between snags and roads, so the proposed decommissioning of roads means more snags would be available in the future within Townsend's big-eared bat habitat, providing more roosting structures.

Under the proposed action, spring, seep, and channel restoration would improve riparian vegetation, increasing availability of food for noctuids and therefore Townsend's big-eared bats over the long term, resulting in indirect beneficial effects.

Determination of Effect

Alternative 2 may affect pale Townsend's big-eared bats, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

The effects of Alternative 3 would be the same as Alternative 2. One documented cave roost is located within an AZGFD research site; however, these treatments are designed to provide tree groups up to 15 acres and can be designed to buffer cave locations as needed. Buffers are designed to eliminate potential sedimentation into the cave or damage from heavy machinery working over shallow passages. Alternative 3 has the same number of acres of grassland restoration treatments, while reducing savannah treatments by 15,000 acres.

Determination of Effect

Alternative 3 may affect pale Townsend's big-eared bats, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for pale Townsend's big-eared bats is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Short-term disturbance to bats would occur during thinning, hauling, and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term effects added to similar effects from other past, present, and reasonably foreseeable projects were considered. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

Implementation of other fuel reduction project activities could occur simultaneously; however, they are not anticipated to combine with Rim Country activities to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally, grazing systems are managed on a rotation to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters. Implementation of the Travel Management Rule has reduced the number of roads near Townsend's big-eared bat roost locations.

Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Allen's Lappet-browed Bat

Alternative 1 – No Action

Under Alternative 1, only current and reasonably foreseeable projects would continue. Habitat would still exist for this species; however, the high fire hazard potential would persist, and a large, uncharacteristically severe wildfire event could have the potential to affect individuals and long-term suitability of habitat. Most of the forested area within the project area is in a moderately closed or closed canopy condition. Under Alternative 1, grasslands and forest openings would not be restored, thus recruitment of large snags would not meet forest objectives in the long term. Large-diameter trees would not maintain the numbers and distribution that would support large-diameter snags distributed across forested areas. There would be reduced foraging habitat for Allen's lappet-browed bats as conifers encroach into meadows and canopy closure increases, resulting in indirect adverse effects. High basal area and trees per acre counts would decrease or stagnate growth of large trees. Active competition-induced mortality would increase, decreasing future recruitment of large snags and decreasing future maternity roost sites.

Determination of Effect

Alternative 1 may affect Allen's lappet-browed bats, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Forest management treatments potentially benefiting bats and their prey include group selection (small groups of trees removed for regeneration of new age classes, which results in a mosaic of roosting habitat, and small to medium gaps for foraging) and single tree selection (individual trees of all size classes removed fairly uniformly). This would ensure a consistent source of large-diameter snags by maintaining recruitment of trees into larger size classes. These treatments would maintain diverse forest structure, including snags and gaps that enhance edge habitat, create diverse vegetation structure, and increase herbaceous vegetation important for bats' insect prey (Taylor 2006).

Thinning and prescribed burning activities could potentially disturb Allen's lappet-browed bats if they are roosting in trees within the ponderosa pine and pinyon juniper treated areas. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning would occur in the spring and fall and burning within 0.5 mile of known roosts/hibernacula or unsurveyed caves and mine shafts would be designed to limit smoke at critical times (April–May and mid-winter).

Prescribed burning could also result in the loss of individual snags which could affect roosting bats; however, mitigation including managing for retention of all snags 18 inches in diameter and greater would reduce this effect. Recruitment snags would be provided by retaining and growing more trees 18 inches in diameter and greater. Selection of trees with dead tops and lightning damage would contribute to potential habitat. The modified proposed action is expected to result in a slight short-term increase in snags followed by a continuing increase over the long term, with incidental loss of snags greater than 18 inches in diameter.

Prescribed burning would result in the removal of cover and food. However, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial effects on bats. Forest conditions after treatment would improve bat habitat within the project area. Increasing diversity and density of understory vegetation provides habitat for prey populations. Many invertebrates are tied to specific understory plant species (Capinera 2010). Indirect benefits could potentially result from restoring meadows encroached by pine trees, as well as reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit Allen's lappet-browed bats and their prey. Moving these habitats toward historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under Alternative 2 there are up to 250 miles of closed roads that could be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting potentially reducing snags along roadways. Ganey (personal communications, 2012) found an inverse relationship between snags and roads, so the proposed decommissioning of roads means more snags would be available in the future within Allen's lappet-browed bat habitat providing more roosting structures.

Under the modified proposed action, spring, seep, and channel restoration would improve riparian vegetation, increasing availability of food for bats over the long term, resulting in indirect beneficial effects.

Determination of Effect

Alternative 2 may affect Allen's lappet-browed bats, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

Alternative 3 treats fewer forest acres in Rim Country, but the direct and indirect effects would be similar to Alternative 2. Alternative 3 includes the same miles and acres of riparian and other habitat restoration, while reducing the total number of acres thinned and treated with prescribed burning. The same grassland restoration acres are proposed as in Alternative 2, but 15,000 fewer acres in forest openings such as meadows and savannahs are proposed. While short-term effects from disturbance would be slightly less to Allen's lappet-browed bats in Alternative 3, the long-term effects on the risk of habitat degradation from stand-altering wildfire or insect infestations would be greater.

Determination of Effect

Alternative 3 may affect Allen's lappet-browed bats, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for Allen's lappet-browed bats is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

. The alternatives would be expected to result in a slight short-term increase in snags (greater than 12 inches diameter) followed by a continued increase over the long term of large snags (greater than 18 inches diameter). These short-term effects added to similar effects from other past, present, and reasonably foreseeable projects were considered.

Implementation of other fuel reduction and restoration activities could occur simultaneously; however, it is not anticipated that these effects would be additive to cause negative effects. Other fuel reduction and restoration projects might result in decreased large snags (greater than 18 inches in diameter) into the future. However, decreasing the potential for large-scale wildfires, and designing projects to increase tree growth for more large trees and, consequently, more recruitment snags, would improve the ability of tree roosting bats to locate roost sites across the landscape.

Prescribed burning produces low-severity burns that would reduce surface fuels and cause periodic loss of snags. Other activities such as high-severity wildfire, construction and maintenance of utility corridors, management of snags along forest roads, and private land development would also reduce the number of snags available for roosting in the long term. Large snags would be preserved whenever possible and design features to maintain and, where possible, develop snags on the landscape are incorporated into all projects. Although individual trees may be lost, large snags would be maintained and developed across the landscape to provide roosting habitat for Allen's lappet-browed bats.

Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotation to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However, wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around water.

Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Spotted Bat

Alternative 1 – No Action

Under Alternative 1, only current and reasonably foreseeable projects would continue, as discussed in the cumulative effects to all species section. However, the high fire hazard potential would persist, and a large, uncharacteristically severe wildfire event would have the potential to affect individuals. Ponderosa pine forest in the project area would be at a high risk of losing key ecosystem components, should there be a disturbance event such as fire or extended drought (Fire Ecology and Air Quality Report). Key ecosystem components in ponderosa pine forest include species composition, forest structure, soil characteristics, and hydrologic function. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals. Although habitat would be provided for this species, most of the forested area within the project area is in a moderately closed or closed canopy condition. Under Alternative 1, grasslands and forest openings would not be restored, thus there would be no benefits to bats. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in indirect adverse effects. Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under Alternative 1. Crown fire potential in ponderosa pine habitat from Alternative 1 could occur in 480,996 acres (87 percent) of this habitat type.

Determination of Effect

Alternative 1 may affect spotted bats, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Forest management treatments potentially benefiting bats and their prey include group selection (small groups of trees removed for regeneration of new age classes resulting in a mosaic of roosting habitat, and small to medium gaps for foraging) and single tree selection (individual trees of all size classes removed fairly uniformly). These treatments maintain diverse forest structure and roost trees, create gaps that enhance edge habitat, and provide diverse vegetation structure increasing herbaceous vegetation important for bats' insect prey (Taylor 2006).

Under the modified proposed action, thinning and prescribed burning activities could potentially disturb spotted bats if they are roosting in rock crevices in the ponderosa pine treated area. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) could have negative effects on local populations. However, most prescribed burning would occur in the spring and fall and burning within 0.5 mile of caves, mines, or cliff habitats would be designed to limit smoke at critical times (April–May and mid-winter).

Prescribed burning would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed burning. These activities would disturb or remove understory vegetation, subsequently reducing availability to insects. These effects would be short-term and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in meadows, restoring meadows, and prescribed burning would encourage the development of understory vegetation, increasing availability of food for the bat over the long term.

Increasing the diversity and density of understory vegetation provides habitat for prey populations. Many lepidopterans are tied to specific understory plant species (Waltz and Covington 2004). Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest, a result of fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit spotted bats and their prey. Moving these habitats toward historic conditions would also increase the resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire. Under the modified proposed action, spring, seep, and channel restoration would improve riparian vegetation, increasing availability of food for bats over the long term, resulting in indirect beneficial effects.

Determination of Effect

Alternative 2 may affect spotted bats, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

Alternative 3 treats fewer forest acres in Rim Country, but the direct and indirect effects would be similar to Alternative 2. Alternative 3 includes the same miles and acres of riparian and other habitat restoration, while reducing the total number of acres thinned and treated with prescribed burning. The same grassland restoration acres are proposed as in Alternative 2, but 15,000 fewer acres in forest openings such as meadows and savannahs are proposed. While short-term effects from disturbance would be slightly less to spotted bats in Alternative 3, the long-term effects on the risk of habitat degradation from stand-altering wildfire or insect infestations would be greater.

Determination of Effect

Alternative 3 may affect spotted bats, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for spotted bat is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

There could be potential short-term disturbance to potential foraging and roosting habitat with long-term benefits from the action alternatives. Short-term disturbance to bats would occur during thinning, hauling, and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term effects, added to similar effects from other past, present, and reasonably foreseeable mechanical vegetation management and fuels reduction projects were considered. Implementation of these projects could occur simultaneously; however, it is not anticipated to accumulate to cause negative effects. Ungulate grazing in the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotation to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However, wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around water.

Alternative 3 would treat less acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Forest Service Management Indicator Species

Tonto National Forest Management Indicator Species

Rocky Mountain Elk

The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for Elk (Tonto National Forest, 2005). No treatment or limited treatments as per previous years of acres accomplished in this forest type would leave nearly 220,000 acres of this (77 percent) untreated. Alternative 1 would not result in an immediate change to the quantity or quality of habitat used by elk on national forests. Alternative 1 would continue to provide large patches of trees with higher basal area, canopy density, and interlocking crowns, thereby providing thermal and hiding cover for elk. However, forage production would be limited under the forest canopies. Pine encroachment into grassy openings and meadows would continue to limit foraging habitat for elk under Alternative 1. Under Alternative 1, the current unnatural stand densities would threaten the sustainability of elk habitat over time by limiting understory production and creating a higher risk for uncharacteristic, high-severity fire.

Alternatives 2 and 3 would not result in a type conversion of mixed conifer or Ponderosa pine habitat on the Tonto National Forest and therefore would have no effect to the population trend for elk. These alternatives would promote thinning trees and prescribed burning in ponderosa pine that would open the canopy and decrease fine fuels on the forest floor. The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for Elk (Tonto National Forest, 2005). The action alternatives could treat up to approximately 226,416 of this habitat on the Tonto National Forest, maintaining or improving the habitat quality of 80 percent of the available habitat on the Tonto National Forest. The result would be increased growth of herbaceous and shrub-level vegetation on these treated acres, which would provide increased forage in the long term. Reducing tree densities and ladder fuels would reduce available thermal and hiding cover for elk. However, thermal protection for elk would continue to be available in areas maintained at higher BA and canopy density.

Merriam's Turkey

The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for turkey (Tonto National Forest, 2005). No treatment or limited treatments as per previous years of acres accomplished in this forest type would leave nearly 220,000 acres of this (77 percent) untreated. Alternative 1 would not result in an immediate change to the quantity or quality of habitat used by turkey on the national forests in the project area. Alternative 1 would continue to provide large patches of trees with a higher basal area, higher canopy density, and more interlocking crowns, thereby providing thermal and hiding cover for turkey. However, overstory suppression of oak, grass, and forb diversity and productivity would continue to limit foraging habitat for turkey in Alternative 1. Tree encroachment into openings and meadows would also limit turkey foraging habitat. Late-seral ponderosa pine would continue to be threatened by unnatural stand densities, creating risk for uncharacteristic, high-severity fire.

Alternatives 2 and 3 would not result in a type conversion of mixed conifer or Ponderosa pine habitat on the Tonto National Forest and therefore would have no effect to the population trend for turkey. The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for turkey (Tonto National Forest, 2005). The action alternatives could treat up to approximately 226,416 of this habitat on the Tonto National Forest, maintaining or improving the habitat quality of 80 percent of the available habitat on the Tonto National Forest. The proposed treatments in Alternatives 2 and 3 would protect nesting and roosting habitat. The proposed thinning and burning activities would create tree groups that are favored by turkeys and would also increase the understory production. Increasing the understory would also increase plant and invertebrate abundance.

Vegetation design features would protect most mast-producing Gambel oaks within the project area. Targeted removal of over-topping ponderosa pines would increase resiliency and persistence of large oaks. Design features also specifically address retaining medium to high canopy cover in stringers of large ponderosa pine trees in the pinyon-juniper transition zones. This is a habitat favored by roosting turkeys. Low- severity prescribed fire along ridges and slopes is expected to retain yellow pine and roosting cover above drainages in the pinyon- juniper transition zone. While turkeys are not grassland species, groups of large and old trees would be retained where they occur on mollic-integrade soils. The results of these treatments would be savanna conditions. This would add resilience to groups of large, old trees, potentially increasing turkey roost habitat. In addition, the open habitat conditions resulting from the grassland and savanna treatments would increase foraging habitat for adults and poults.

Abert's Squirrel

The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for Abert's squirrels (Tonto National Forest, 2005). No treatment or limited treatments as per previous years of acres accomplished in this forest type would leave nearly 220,000 acres of this (77 percent) untreated. Alternative 1 would continue to provide large patches of trees with higher basal area, canopy density, and interlocking crowns, thereby providing wintering habitat for squirrels on national forests. However, Alternative 1 would threaten the long-term viability of squirrels. Under Alternative 1, the current unnatural stand densities would threaten the sustainability of squirrel habitat over time by reducing tree vigor and health, limiting pine cone production, and creating a risk for uncharacteristic, high-severity fire. Vigor and health of trees in the older age class categories are important for sustaining squirrel nesting habitat over time. Pine cone production is important for squirrel foraging and nutritional demands. Large-scale losses of squirrel habitat from uncharacteristically large, stand-replacing fire would affect squirrel populations across the project area.

Alternatives 2 and 3 would not result in a type conversion of mixed conifer or Ponderosa pine habitat on the Tonto National Forest and therefore would have no effect to the population trend for Abert's squirrels. The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for Abert's squirrels (Tonto National Forest, 2005). The action alternatives could treat up to approximately 226,416 of this habitat on the Tonto National Forest, maintaining or improving the habitat quality of 80 percent of the available habitat on the Tonto National Forest. With rare exceptions, Alternatives 2 and 3 would not remove old growth trees, and there would be an emphasis on retention of large-diameter trees, which should benefit Abert's squirrels for nesting, winter cover, and cone production. Project design criteria include tree thinning using the goshawk guidelines. This should result in a mosaic of vegetation structural stages, interrupting canopy closure, and allowing more sunlight to reach the forest floor. The reduction in canopy connectedness would reduce safe travel routes for Abert's squirrels and expose them to higher rates of predation in treatments creating more higher degrees of openness,. These treatments would also expose more of the forest floor to direct sunlight which could remove the microsite habitat for mycorrhizal fungi production, thereby reducing an important food source for squirrels. However, Dodd et al. (2006) postulated that up to 75 percent of a forested landscape could be treated and still provide suitable squirrel habitat, if treatments were applied as a mosaic of patches and areas of optimal habitat were retained. The alternatives are also designed to provide closed-canopy corridors to provide connectivity for squirrels and other species.

Alternatives 2 and 3 call for a diverse range of mechanical treatments to maintain forest habitat. Forest habitats would vary from 10 to 70 percent open, outside of grassland and savanna habitat, with variable basal area, trees per acre, and stand density index depending on site-specific conditions. Areas that would likely maintain a basal area and canopy cover high enough to support Abert's squirrels include MSO protected and recovery habitat, northern goshawk nest stands, other raptor nest sites, bald eagle roosts, buffers around caves and sinkholes, a portion of the older age class tree groups intended to support higher tree densities of mixed-age trees, and areas excluded from mechanical treatment such as wilderness or areas with slopes greater than 40 percent. As such, the patches of forest within the mosaic proposed by Alternatives 2 and 3 would vary in terms of Abert's squirrel habitat quality. A ratio of optimal to suboptimal patches that is skewed toward a more open condition would be less desirable to the squirrel and could lead to a short-term reduction in current squirrel populations. However, in the long term, post-treatment conditions would include tree growth and increased canopy connectedness, which should have a positive effect onto squirrel populations when viewed over longer time horizons.

Despite the proposed overall reduction in dense forest conditions, alternatives 2 and 3 would also provide for sustainable forests that include large, cone-bearing trees either as individual legacy trees or in groups, and clumps of mature and old-growth trees interspersed with patches suitable for fungi production. Canopy connectivity would be retained, but would no longer occur across so much of the landscape. In the long term, this should provide for more sustainable squirrel habitat over time because the risk of high-severity fire, and therefore long-term degradation or loss of squirrel habitat, would be significantly reduced (USDA FS 2010a). Landscape connectivity would be retained for canopy-dependent species.

Arizona Gray Squirrel

Alternative 1, No action could lead to a decreased species trend if effects from high-severity wildfire is encountered in high elevation riparian habitat across the project area.

Alternatives 2 and 3 would not result in a type conversion of riparian habitat on the Tonto National Forest and therefore would have no effect to the population trend for Arizona gray squirrels. The action alternatives would emphasize maintenance and restoration of healthy riparian ecosystems through conformance with LRMP's riparian Desired Conditions. Management strategies should move degraded riparian vegetation toward good condition as soon as possible. Damage to riparian vegetation, stream banks, and channels should be prevented. Alternatives 2 and 3 would improve riparian habitat and would likely assist in keeping the population stable.

Common Black Hawk

Alternative 1, No action could lead to a decreased species trend if effects from high-severity wildfire is encountered by riparian and cottonwood-willow vegetation type habitats across the project area.

Alternatives 2 and 3 propose 14,560 acres of Riparian restoration. Improvement of stream function is proposed for 777 miles across the project area through the action alternatives. Black-hawks could be disturbed by restoration activities, however design features to protect raptor nests have been included in the project record. This should minimize disturbance to the Common Black-hawk, though it is possible that disturbance from thinning implementation and short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. The removal of any eggs or fledglings would not result in a measurable negative effect to the Common Black-hawk population from any of the two action alternatives as the implementation of these acres would occur intermittently over space and time over the next 10 years. Long-term effects to the Common Black-hawk population would be positive as a result of habitat restoration. Alternatives 2 and 3 would improve riparian and cottonwood-willow vegetation types habitats and would likely assist in keeping the population stable.

Ash-throated Flycatcher

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. Long-term benefits would include increasing understory development, managing for snag retention, and increasing habitat heterogeneity. Areas with currently dense conditions would be more open, leading to mixed long-term results for some species of birds. Unintentional take is expected to be minimized through the application of breeding season timing restrictions in Goshawk PFAs, deferral areas, and other design features. Alternatives 2 and 3 would improve the pinyon-juniper vegetation type habitat and would likely keep the population stable.

Gray Vireo

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. However, mechanical treatment and burning could destroy nests if these activities occur during breeding season. Short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. Not all treatments would occur during the breeding season. Unintentional take of eggs or nestlings would not result in a measurable negative effect to the Gray Vireo population from both of the action alternatives. Alternatives 2 and 3 would improve the pinyon-juniper vegetation type habitat and would likely assist in keeping the Gray Vireo population stable.

Juniper Titmouse

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. However, mechanical treatment and burning could destroy nests if these activities occur during breeding season. Short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. Not all treatments would occur during the breeding season. Unintentional take of eggs or nestlings would not result in a measurable negative effect to the juniper titmouse population from either of the action alternatives.

Hairy Woodpecker

Alternative 1 would increase the amount of late-seral forests in the long term. The risk of a large-scale wildfire is high. While fires promote recruitment of large snags, a study conducted locally, documented 40 percent of fire-killed snags falling within 7 years (Chambers and Mast 2005). Over 80 percent of ponderosa pine snags created by high-severity fire fell within 10 -years after a fire (Chambers personal communications 2008, Mast personal communications 2008). In addition, patches that burn with high-severity in today’s stand-replacing fires can reach several hundred hectares in size. Hairy woodpeckers do not use interior portions of larger burned areas, restricting much of their foraging to the edge habitat. The uncharacteristically large fires of recent years are less valuable to hairy woodpeckers than the smaller overstory-removing fires that occurred historically (USDA FS 2010a).

Live conifer trees with the potential to provide nesting habitat cavities such as dead-top trees and lightning struck trees would also be favored for retention. Prescribed fires would be designed to maintain desired forest structure, tree densities, snag densities, and coarse woody debris levels. Using the goshawk guidelines to direct management activities should have a positive effect on the species, as these prescriptions would result in forest structure that more closely resembles historic forests than those present today, including large trees and an abundance of snags (USDA FS 2010a).

Northern Goshawk

In Alternative 1, the quality of the habitat would deteriorate as canopies close tree densities increase, and understory production decreases. Closed canopies associated with higher tree densities would not allow sunlight and water to reach the forest floor for understory vegetation to grow, or provide habitat for prey species including vegetative cover, nesting substrates, seeds and fruits, grasses, forbs, and shrubs, as evidenced by the declining index of biomass production. In the long term, understory species richness would decline, reducing food and cover for prey species. Increased tree densities would increase competition among trees. Tree growth would decrease or stagnate and tree health decline due to competition for limited resources and space. Meanwhile, the lack of fire disturbance has led to increased tree density and fuel loads that increase the risk of uncharacteristically intense wildfire and drought-related mortality. When fires occur under current conditions, they tend to cause high tree mortality rates, including the large and old trees. These trees take longer to replace, moving the forest further from desired conditions, and increasing the time it would take to return to desired conditions. Another result of increased tree density is increased risk of insect and/or disease outbreak. Mortality created by these outbreaks also contributes to increased fuel loads and associated increase in the risk of uncharacteristically intense wildfire.

In Alternatives 2 and 3, the large tree habitat structure required for goshawk nesting (for example, large, tall trees with large branches and adequate flight paths) would be more available across the landscape as the numbers of large trees increases, improving habitat for existing and future resident goshawks and potentially increasing recruitment into the population. Creating interspace between groups of trees would help support prey species. Trees used for nesting would be able to grow to larger size, retain more of their crowns, and live longer with less competition, thus providing higher quality habitat for nesting and foraging.

The quality of the late seral stage ponderosa pine habitat would be expected to improve as stand conditions move closer toward historic conditions with more open understories, less competition among trees, and healthier forest conditions. Increasing the understory response would improve the quality of goshawk foraging habitat by providing more food and cover for prey species. The improved development of understory could also increase the diversity and amount of prey species available to goshawks.

Alternatives 2 and 3 would produce the largest increase in the quantity of late seral ponderosa pine habitat as well as the most improvement in the quality of habitat for northern goshawks and their prey species as all elements move toward desired future conditions. Overall, Alternatives 2 and 3 increase habitat quantity and improve habitat quality for northern goshawk and its prey species.

Northern Flicker

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. However, mechanical treatment and burning could destroy nests if these activities occur during breeding season. Short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. Not all treatments would occur during the breeding season. Unintentional take of eggs or nestlings would not result in a measurable negative effect to the Northern flicker population from both of the action alternatives. Alternatives 2 and 3 would improve the pinyon-juniper vegetation type habitat and would likely assist in keeping the Northern flicker population stable.

Townsend’s Solitaire

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. However, mechanical treatment and burning could destroy nests if these activities occur during breeding season. Short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. Not all treatments would occur during the breeding season. Unintentional take of eggs or nestlings would not result in a measurable negative effect to the Townsend's solitaire population from both of the action alternatives. Alternatives 2 and 3 would improve the pinyon-juniper vegetation type habitat and would likely assist in keeping the Townsend's solitaire population stable.

Violet-green Swallow

Alternative 1 would lead to a decreased species trend if high-severity wildfire is encountered in the ponderosa pine/snags vegetation type habitat across the project area.

Alternative 1 would not result in an immediate change to the quantity or quality of habitat used by Violet-green swallows. Late-seral ponderosa pine would continue to be threatened by unnatural stand densities, creating risk for uncharacteristic, high-severity fire.

The proposed treatments in Alternatives 2 and 3 would protect nesting habitat. The proposed thinning and burning activities would also create canopy openings, allowing sunlight to reach more tree boles and increasing the prey base for swallows. Thinning and burning treatments are designed to return forest structure and composition to within the natural range of variation, which should benefit native wildlife species (Kalies et al. 2010). The vegetation design features for Alternatives 2 and 3 require that snags be managed to meet or move toward forest plan requirements and to move toward desired conditions. Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas, conifer snags greater than 12 inches in diameter would be maintained, with an emphasis on snags greater than 18 inches in diameter, except in cases of human health and safety. Live conifer trees with the potential to provide nesting habitat cavities, such as dead-top trees and lightning struck trees, would be favored for retention. Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities, and coarse woody debris levels.

Western Bluebird

Alternative 1 would lead to a decreased species trend if high-severity wildfire is encountered in the ponderosa pine open vegetation type habitat across the project area.

Alternative 1 would not result in an immediate change to the quantity or quality of habitat used by Western bluebirds. Late-seral ponderosa pine would continue to be threatened by unnatural stand densities, creating risk for uncharacteristic, high-severity fire.

The proposed treatments in Alternatives 2 and 3 would protect nesting habitat. The proposed thinning and burning activities would also create canopy openings, allowing sunlight to reach more tree boles and increasing the prey base for bluebirds. Thinning and burning treatments are designed to return forest structure and composition to within the natural range of variation, which should benefit native wildlife species (Kalies et al. 2010). The vegetation design features for Alternatives 2 and 3 require that snags be managed to meet or move toward forest plan requirements and to move toward desired conditions. Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas, conifer snags greater than 12 inches in diameter would be maintained, with an emphasis on snags greater than 18 inches in diameter, except in cases of human health and safety.

Live conifer trees with the potential to provide nesting habitat cavities, such as dead-top trees and lightning struck trees, would be favored for retention. Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities, and coarse woody debris levels.

Western Wood Peewee

Alternative 1 would lead to a decreased species trend if effects from high-severity wildfire is encountered by forested areas adjacent to riparian vegetation type habitats across the project area.

Alternatives 2 and 3 propose 14,560 acres of riparian restoration. Improvement of stream function is proposed for 777 miles across the project area in both action alternatives. Restoration of approximately 900,000 acres of forested habitat could occur with Alternative 2 and approximately 474,000 acres in Alternative 3.

Western wood peewees could be disturbed by restoration activities, however design features to protect raptor nests have been included in the project record. This should minimize disturbance to the Western wood peewees, though it is possible that disturbance from thinning implementation and short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. The removal of any eggs or fledglings would not result in a measurable negative effect to the Western wood peewee population from any of the two action alternatives as the implementation of these acres would occur intermittently over space and time over the next 10 years. Long-term effects to the peewee population would be positive as a result of habitat restoration. Alternatives 2 and 3 would improve areas adjacent to riparian vegetation habitats and would likely assist in keeping the population stable.

Cumulative Effects

Some MIS are much more mobile than others. Therefore it is important to recognize habitat outside the project area as the affected environment for some animals. The cumulative effects analysis area varies by species (Table 80). The analysis includes the combined effects from all activities within the area as evaluated for each alternative. For example, the Abert’s squirrel typically does not travel far; they stay in ponderosa pine forest year-round instead of migrating to lower elevations for the winter. Therefore, its cumulative effects analysis area is the ponderosa pine habitat type within the project area. On the other hand, elk use much larger areas to mate, calve, graze, and overwinter, so the cumulative effects analysis area for elk includes habitat outside the project area.

Cumulative effects can be an integral part of the effects analysis for wildlife and are discussed for each species. The cumulative effects discussed have occurred since 2001 and are considered changes in existing condition. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Table 80. Cumulative effects analysis area by species

Cumulative Effects Analysis Area	Species	Reason for Selection
Within project area	Pygmy nuthatch, turkey, Abert's squirrel, hairy woodpecker, red-naped sapsucker, juniper titmouse, Grace's warbler, western bluebird	Abert's squirrel use is focused on the area around their nest trees. Birds may move to other areas, but their nesting habitat is the most limiting factor for these species.
Project area plus 0.25-mile buffer around project area	Goshawk	The 0.25-mile buffer takes into account potential disturbances from activities within the project area.
Game management unit	Elk, mule deer, pronghorn	These species have wider mobility; GMUs are designed to encompass herd movements.

Alternatives 2 and 3

The planned thinning and burning of ponderosa pine and mixed conifer habitat would help reduce small tree densities and help move habitat toward historical stand structures. These treatments would have the same benefits discussed in Alternative 1, but when added to the additional treatments in the alternatives, would provide for improvement across the landscape. These treatments would affect the MSO, Northern goshawk, Pygmy nuthatch, Rocky Mountain elk, Merriam's turkey, Abert's squirrel, Violet-green swallow, Hairy woodpecker, Western bluebird, and Western wood peewee by improving their habitats in the long term. These species' forestwide habitat trends would be improved by thinning projects that retain and enhance the large tree component within the ponderosa pine forest and that help create and retain large snags.

The 36,340 acres of grassland restoration, 17,600 acres of ponderosa pine savanna treatments, and 6,760 acres of meadow treatments would benefit pronghorn and elk by creating forage and corridors for movement between areas.

Treatment is possible on up to 115,000 acres of pinyon-juniper habitat. Design features would preserve older trees in this habitat type so effects from treatments to these MIS populations (Ash-throated flycatcher, Gray vireo, Juniper titmouse, Northern flicker and Townsend's solitaire) are expected to be minimal.

Fuelwood gathering and travel management requirements together help determine where the public can legally collect fuelwood. Since off road travel is only allowed in fuelwood areas, this would limit how far the public can travel to collect fuelwood. This would likely leave more dead and down woody material in areas farther from roads. There would likely be less dead woody material available within fuelwood areas closer to roads. This could prevent achieving forest plan requirements for snags, logs, and dead and down woody material near some roads. This would also limit how much fuelwood is removed away from roads and increase fuelwood removal along roads. Proposed treatments should help limit the amount of area not meeting forest requirements. This would affect the Northern goshawk, Pygmy nuthatch, Hairy woodpecker, Violet-green swallow, Northern flicker, and Juniper titmouse by removing snags that are needed for nesting or prey species.

The effects on MIS from ongoing and foreseeable activities, along with the proposed activities in Alternatives 2 and 3, are as follows: For all of the MIS species, the cumulative effects from these projects **would not adversely change the predicted forestwide habitat and population trends**.

Migratory Birds and Important Bird Areas

In the Mogollon Rim Snowmelt Draw Important Bird Area, the Rim Country Project would affect approximately 45,673 acres of ponderosa pine, aspen, pinyon-juniper, grasslands and savannas, ephemeral streams, and spring habitats. Mexican spotted owl protected, recovery, and critical habitats occur in the Important Bird Area. All design features associated with these habitat types would be followed as discussed in previous sections of this report.

Effects of the Proposed Activities on Migratory Birds

Currently, many migratory birds depend on habitats or habitat elements related to canopy openings, snags, and early seral conditions. Existing closed canopy forests limit or eliminate many of the necessary habitat components needed by these species, such as understory development sufficient to support abundant seeds, arthropods, and cover. The desired condition of closed canopy tree groups interspersed with open rooting space that supports herbaceous vegetation would provide key habitat components for these species of status as well as species adapted to closed-canopy forests. The ability to grow and maintain large trees would provide consistent development of future snags.

Table 81. Long-term effects on migratory bird habitats from Alternatives 2 and 3

Species	Habitat Links	Long-Term Effect to Habitat
Northern Goshawk	Late-seral PIPO[1]/Prey Habitat	Improved
Flammulated Owl	PIPO/openings/insects/snags	Improved
Cordilleran Flycatcher	PIPO/insects/ oak/dense forest	Mixed
Grace's Warbler	PIPO/openings/insects/	Improved
Olive Warbler	PIPO/openings/insects/	Improved
Lewis's Woodpecker	PIPO/openings/insects/snags	Improved
Purple Martin	PIPO/openings/insects/snags	Improved
Cassin's Finch	PIPO/openings/seeds	Improved
Common Nighthawk	PIPO/openings/insects/	Improved
Mexican Whip-poor-will	PIPO/openings/insects/	Improved
Olive-sided Flycatcher	MC/openings/insects/snags	Improved
Evening Grosbeak	MC/openings/seeds	Improved
Red-faced Warbler	MC/oak/willow/insects/	Improved
Band-tailed Pigeons	MC/oak/willow/seeds/	Improved
Red-naped sapsucker	Aspen	Improved
Black-chinned Sparrow	Interior Chaparral	Mixed
Gray Vireo	Pinyon-juniper	Improved
Pinyon Jay	Pinyon-juniper	Improved
Juniper titmouse	Pinyon-juniper	Mixed
Black-throated Gray Warbler	Pinyon-juniper	Improved
Gray Flycatcher	Pinyon-juniper	Improved
Swainson's Hawk	Open/Grassland	Improved
Ferruginous Hawk	Open/Grassland	Improved
Burrowing Owl (western)	Open/Grassland	Improved
Grasshopper Sparrow	Open/Grassland	Improved
Bendire's Thrasher	Open/Grassland	Improved
Chestnut-collared Longspur	Semidesert Grassland	Improved

Species	Habitat Links	Long-Term Effect to Habitat
Lark Bunting	Semidesert Grassland, Desert Communities	Improved
Common Black-Hawk	Cottonwood/willow/riparian forest.	Improved
Bell's Vireo	Cottonwood Willow Riparian Forest	Improved
Elf Owl	Cottonwood Willow Riparian Forest	Improved
Lucy's Warbler	Cottonwood Willow Riparian Forest	Improved
Yellow Warbler	Cottonwood Willow Riparian Forest; Mixed Deciduous Riparian Forest	Improved
Lincoln's Sparrow	Montane Willow Riparian Forest (breeding)	Improved
MacGillivray's Warbler	Montane Willow Riparian Forest, Aspen and Maple, Mixed Conifer	Improved
Brewer's Blackbird	Wetlands, Montane/Subalpine Grasslands, Montane Willow Riparian Forest	Improved
Wood Duck	Cottonwood Willow Riparian Forest	Improved
Phainopepla	Desert Communities	None
Savannah Sparrow	Open habitats project-wide	Improved

Important Bird Areas

Most of the major vegetation cover types within the Mogollon Rim Snowmelt Draw IBA would be affected by Alternatives 2 and 3. The habitat of this IBA includes Ponderosa pine, white fir, Douglas fir, southwestern white pine, quaking aspen, and Gambel oak. Young plants of these canopy trees, plus canyon maple and New Mexico locust dominate the understory woody species. While most of the acres treated are within ponderosa pine and dry mixed conifer habitats, treatments would also occur in savannah, meadows, aspen, and pinyon juniper habitats. In addition, 53 miles of road decommissioning, restoration of six springs, and 7.5 miles of ephemeral stream channel restoration activities are proposed within the IBA in Alternatives 2 and 3. Design features (Appendix 5) are included in the project to reduce effects on bird species.

Overall, treatment objectives are to help restore forests to their natural range of variation.

Project activities including road decommissioning and spring and stream channel restoration, would help restore the area to more natural conditions. This should improve habitat conditions for all bird species that use the project area. There could be some limited effects on the species due to activities that might occur during the breeding season. It is expected that the habitats for which the Important Bird Area was established would benefit from the proposed treatments.

Cumulative Effects on Migratory Birds

Because of their seasonal movement, the primary management concern for migratory birds is nesting habitat and, for bald eagles, winter roost sites and known nest sites. The cumulative effects analysis area for migratory birds is the project area. The effects from projects that have already been implemented were used to help describe current conditions of the project area and will not be discussed in this section. Ongoing and reasonably foreseeable activities are listed in the cumulative effects for all alternatives section. Cumulative effects discussed here include those that have occurred since 2001 and the effects of the Rim Country alternatives. The timeframe considered is approximately 20 years in the future, at which time the majority of the activities proposed would have been completed and the vegetation response to these actions would have occurred. For further analysis on cumulative effects to migratory birds see the wildlife specialist report.

The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

Alternative 3 would treat fewer acres overall proposing 529,060 acres of treatment (424,070) less than Alternative 2 which cumulatively would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Resulting forest structure from planned thinning and burning of 195,405 acres of ponderosa pine habitat outside of the Rim Country boundary would be habitat within the natural range of variation. In the long term, wildlife species are less likely to be adversely affected by treatments that result in habitat conditions consistent with those of their evolutionary past and so are expected to respond positively to the ongoing and proposed thinning projects (Kalies et al. 2010). These treatments would improve habitat for most birds species associated with the ponderosa pine cover type in the long term (for example, bark gleaners, woodpeckers, and flycatchers), but may negatively affect foliage gleaners in the short term (Patton and Gordon 1995, George et al. 2005). For further information about the cumulative effects to migratory birds from alternatives 2 and 3 see the wildlife specialist report.

The proposed project would treat between 42,486 to 43,863 acres of habitat within the Important Bird Area. This would cumulatively improve habitat condition within a broader area of the Important Bird Area.

Seasonal restrictions would limit project implementation activities between March 1 and September 30 in goshawk nest areas and post-fledging family areas and within Mexican spotted owl protected activity centers, which would reduce the potential for loss of species in ponderosa pine habitat. Prescribed fire could also occur in the fall, outside of the spring nesting season. Since only a small percentage of habitats would be treated at any one time, the loss of eggs or nestlings would not result in a measurable negative effect on the migratory birds populations listed above.

Locally Important Species

Two locally important species that occur in the project area were identified by Forest Service and US Fish and Wildlife biologists. The Arizona toad and the Arizona Black Rattlesnake.

The project could affect individual animals. Snakes or toads could be hit by vehicles associated with project implementation. Activities related to implementation could disturb individuals or interfere with hunting or foraging. However, overall there would not be a measurable negative effect on these two species populations. Long-term habitat improvements would include improved habitat and a decrease in potential disturbance from road decommissioning.

Aquatics

The analysis of aquatic biota and habitat, as well as the endangered, threatened, and sensitive aquatic species and their occupied, critical, and recovery habitats, that occur within the Rim Country project area is part of the Aquatics Report (Coleman 2019), which is incorporated by reference.

Affected Environment

The following section described the affected environment and effects of alternatives relating to threatened, endangered, and Forest Service sensitive species that may occur or have habitat in the project area. The analysis presented is summarized from the following report which is incorporated by reference: Aquatic Specialist Report for Rim Country, by Stephanie Coleman, 2019.

The indicator for riparian/wetland vegetation was used as a surrogate for riparian condition. A more comprehensive analysis of Watershed Condition Framework scores for the Rim Country Project Area as they relate to aquatic species and habitats can be found in the Aquatic Specialist Report (Coleman 2019)

Riparian Condition

Riparian Condition by aquatic species was determined averaging the Watershed Classification and Assessment Tracking Tool (WCATT) scores for the riparian vegetation indicator for all subwatersheds within a species action area. This provides an overview of the riparian condition as it relates to each species and their associated habitat. Averages from 1 to 1.4 are considered Good, 1.5-2.4 is Fair, and 2.5-3.0 is Poor (Table 82).

Four species have riparian condition rated in good condition which equates to functioning properly. Proper functioning condition indicates adequate vegetation, landform, and/or large woody debris are present to:

- Dissipate stream energy associated with high waterflow, thereby reducing erosion and improving water quality.
- Capture sediment and aid floodplain development.
- Improve flood-water retention and ground-water recharge.
- Develop root masses that stabilize streambanks against erosion.
- Maintain channel characteristics.

These watersheds have native vegetation in proper functioning condition throughout the stream corridor or along wetlands and water bodies. Native plant communities are vigorous, healthy and diverse in age, structure, cover and composition on greater than 80 percent of the riparian/wetland areas in the watershed. Sufficient reproduction of native species is occurring to ensure sustainability. Mesic herbaceous plant communities occupy most of their site potential and vegetation is in a dynamic equilibrium appropriate to the system.

Six species have riparian condition rated in fair condition, which is considered Functioning at Risk. These riparian areas are in limited functioning condition; however, existing hydrologic, vegetative, or geomorphic attributes make them susceptible to impairment. Disturbance partially compromises proper functioning condition of native vegetation attributes along stream corridors, wetlands, or water bodies. Native vegetation demonstrates a moderate loss of vigor, reproduction and growth, or changes in composition; particularly in areas most susceptible to human impact. Areas displaying light to moderate impact to structure, composition and cover may occupy 25 to 80 percent of the overall riparian area with only a few areas displaying significant impacts. Up to 25 percent of species cover or composition occurs from early seral species, but the communities across the watershed are still dominated by mid to late seral stages. Xeric herbaceous communities exist where water relationships have been altered but are relatively small, localized, and do not dominate across the watershed.

Four species have riparian condition rated in poor condition, which are considered Impaired. These riparian areas clearly are not providing adequate vegetation, landform, or woody material to dissipate stream energy associated with moderately high flows, and thus are not reducing erosion, improving water quality, etc. large percentage of native vegetation attributes along stream corridors, wetlands, and water bodies are not in proper functioning condition. Native vegetation is vigorous, healthy and diverse in age, structure, cover and composition on less than 75 percent of the riparian/wetland areas in the watershed. Native vegetation demonstrates a noticeable loss of vigor, reproduction and growth, and changes in composition as compared with site potential communities. In these areas, cover and composition are strongly reflective of early seral species dominance although there would be late and mid seral species present in pockets. Mesic dependent herbaceous vegetation is limited in extent with many lower terraces dominated by xeric species most commonly associated with uplands. Reproduction of mid and late seral species is very limited. For much of the area, the water table is disconnected from the riparian area and the vegetation reflects this loss of available soil water.

Table 82. Average riparian condition from WCATT for species analysis areas

Species	Riparian Condition	Associated Rating
Gila trout	2.3	Fair
Gila chub	2	Fair
Gila topminnow	1	Good
Little Colorado spinedace	2.3	Fair
Loach minnow	1	Good
Razorback sucker	1	Good
Spikedace	1	Good
Narrow-headed gartersnake	2.5	Poor
Northern Mexican gartersnake	2.7	Poor
Desert sucker	2.6	Poor
Sonoran sucker	2.7	Poor
Little Colorado sucker	2.3	Fair
Headwater chub	2.4	Fair
Roundtail chub	2	Fair

Federally-listed and Forest Service Sensitive Species lists for all three Forests were screened to determine species that occur or have suitable habitat with the project and action area. Eleven federally listed species and nineteen sensitive aquatic species occur within the three Forests. Of those, nine federally listed and 16 sensitive individual species will be analyzed in detail (Table 83 and Table 84). Two of the species (gartersnakes) are both federally listed and sensitive species.

Table 83. Federally-listed and Forest Service Sensitive Aquatic Species Expected in the Project Area

Species	Status	Occurrence	Notes
Gila trout (*Oncorhyncus gilae*)	Federally Threatened	Documented Occurrence	Occurs within the Project and Action areas

Species	Status	Occurrence	Notes
Little Colorado Spinedace (*Lepidomeda vittata*)	Federally Threatened, with designated Critical Habitat	Documented Occurrence	Occurs within the Project and Action areas
Gila chub (*Gila intermedia*)	Federally Endangered with designated Critical habitat	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Gila topminnow (*Poeciliopsis occidentalis occidentalis*)	Federally Endangered	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Razorback sucker (*Xyrauchen texanus*)	Federally Endangered with designated Critical habitat	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Loach minnow (*Tiaroga cobitis*)	Federally Endangered with designated Critical habitat	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Spikedace (*Meda fulgida*)	Federally Endangered with designated Critical habitat	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Narrow-headed gatersnake (*Thamnophis rufipunctatus*)	Federally Threatened, with proposed Critical Habitat & Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Northern Mexican gartersnake (*Thamnophis eques*)	Federally Threatened, with proposed Critical Habitat & Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Desert sucker (*Catostomus clarki*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Sonoran sucker (*Catostomus insignis*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Little Colorado sucker (*Catostomus sp. 3*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Headwater chub (*Gila nigra*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Roundtail chub (*Gila robusta*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Netwing Midge (*Agathon arizonicus*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area.
A Mayfly (*Fallceon eatoni*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Stonefly (*Capnia caryi*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
Parker's cylloepus riffle beetle (*Cylloepus parkeri*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.

Species	Status	Occurrence	Notes
A Mayfly (*Fallceon eatoni*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Mayfly (*Moribaetis mimbresaurus*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Caddisfly (*Lepidostoma apache*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Caddisfly (*Lepidostoma knulli*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Caddisfly (*Limnephillus granti*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat of springs in ponderosa pine exist.
A Caddisfly (*Wormaldia planae*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Action area
Ferris' Copper (*Lycaena ferrisi*)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat of herbaceous wetlands exist.
Nokomis Fritillary (aka Great Basin Silverspot) (*Speyeria nokomis nokomis*)	Forest Service Sensitive	Documented Occurrence	Little is known about the species, but suitable habitat of herbaceous wetlands and streams exist.
Fossil springsnail (*Pyrgulopsis simplex*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Action area
California floater (*Anodonta californiensis*)	Forest Service Sensitive	Documented Occurrence	Occurs within the Project and Action areas

Table 84. Federally-listed and Forest Service Sensitive Aquatic Species not analyzed in detail

Species	Status	Occurrence	Notes
Apache trout (*Oncorhyncus gilae apache*)	Federally Threatened	No Documented Occurrence	Does not occur within the Project or Action Area
Colorado pikeminnow (*Ptychochelus lucius*)	Experimental-Nonessential Population	No Documented Occurrence	Does not occur within the Project or Action Area
A Caddisfly (*Wormaldia planae*)	Forest Service Sensitive	Not Suspected to Occur	Does not Occur in the Project Area, and elevation range is lower than that of the project.
Balmorhea Saddle-Case Caddisfly (*Protoptila balmorhea*)	Forest Service Sensitive	Not Suspected to Occur	Does not Occur in the Project or Action Area, associated ERU semidesert grassland does not occur.

Assumptions and Methodology

Assumptions

Species occurrence geospatial layers utilized for analysis contain up-to-date information as of July 2018 and represent species current occurrence as well as potential suitable habitat.

Species analysis areas represent the drainage network where direct and indirect effects could occur to species or habitat.

Watershed Condition Framework assessments utilized for existing condition accurately reflect indicators for aquatic species and habitats.

Analyzing mechanical vegetation and prescribed burning treatments across vegetation types will address the highest level of effects that may occur; therefore, effects less than that are inherently addressed.

Project implementation would include all applicable Design Features, Best Management Practices, and Conservation Measures which are expected to minimize effects throughout the analysis.

The Aquatic and Watershed Flexible Toolbox Approach is adaptive management and guidance within the document would be implemented, including circumstances on where treatments are applicable, which inherently minimize effects on aquatic species and habitats.

Projects lists and acreages provided for Cumulative Effects analysis accurately represent past, current, and future activities within the project area.

Methodology

This analysis is for a total of 28 endangered, threatened, proposed, candidate, and sensitive aquatic species and their habitats. The species analyzed include twelve fish species, two mollusks, two gartersnakes, and twelve invertebrates. For analysis and discussion purposes, some of the species were grouped together, where appropriate, as this facilitates the comparison of changes between alternatives. Analyses compared and summarized the resource indicators and measures identified below (see Table 85). For invertebrate species, more qualitative analyses were required, primarily due to the unknown distributions of most of these species, limited distribution of these species, or the limited effects on these species associated with the proposed actions. Analyses included the changes (such as, increase, decrease, or change from current conditions) for the indicators or measures, and how they can affect aquatic species and their habitats.

For the purposes of analysis, mechanical vegetation treatments were analyzed across vegetation type (Ecological Restoration Unit) within the project area. Intuitively, mechanical vegetation treatments in forested Ecological Restoration units (ERUs) would be more extensive to move towards desired conditions than treatments in savannas, grasslands, meadows, and riparian areas to reduce encroachment. Prescribed burning was similarly analyzed across the project area regardless of vegetation type (ERUs).

The transportation system (roads) needed to implement Rim Country were analyzed quantitatively and qualitatively. Quantitative analysis was completed based on existing Forest Service roads (existing condition) and the number of ML-1 roads opened (action alternatives). While the analysis assumes all ML-1 roads would be opened for use, intuitively not all the roads would be opened or used at the same time across the project area. Therefore, the analysis is over estimating the potential effects of the action alternatives. The miles of roads (ML-1 thru 5) to be used is the same for both action alternatives as was therefore analyzed only once. Road relocation, decommissioning, and temporary roads were analyzed qualitatively for the action alternatives as the location of these activities is unknown. Miles proposed for each were based on averages across the three Forests over a given time period. Therefore, a more accurate analysis by species was not feasible. Miles of proposed road relocation and decommissioning were the same for both action alternatives and therefore only analyzed once. Mileage of temporary roads differed between the action alternatives and was analyzed as part of those alternatives.

In-woods processing and storage sites, rock pits, and aquatic/watershed restoration activities do not differ in acreage or mileage between the action alternatives. For those reasons, these three portions of the action alternatives were analyzed only once as Effects Common to Both Action Alternatives. In-woods processing and storage sites were analyzed quantitatively for the Coconino and Tonto National Forests where exact locations and acreages of proposed sites were available. A qualitative analysis was completed for the Apache-Sitgreaves National Forests because the use of identified processing sites on those forests are not being proposed, only the in-woods drying of biomass as needed. The acres of rock pit use and expansion were analyzed quantitatively, as were miles of general and heavy mechanical stream restoration.

Spatial and Temporal Context for Effects Analysis

The spatial analysis area includes the entire Rim Country project Area and adjacent areas that could be affected by activities occurring downstream of the proposed project area, or adjacent lands. The analysis area will vary by the species present within and downstream of Rim Country subwatersheds, and the extent and location of proposed activities within the various alternatives. For GIS quantitative analyses, areas for most of the aquatic species were developed to include all potential effects. Species analysis area boundaries were determined by including all of the subwatersheds within the project area that drain into occupied or suitable habitat, designated or proposed critical habitat, and identified recovery habitat. Additional spatial boundaries within each species analysis areas were defined specifically to delineate direct and indirect effects; these are described below.

Miles of stream identified for general and heavy mechanical stream restoration were identified spatially using factors that promote successful treatments. Potential locations for general stream treatments were identified based on stream gradient. Stream gradient was mapped using LiDAR data and averaging within reaches. Reaches with low (0 to 2 percent) and moderate (2 to 4 percent) stream gradient were used for general stream treatment identification based on Rosgen stream types and gradients where stream restoration is the most successful. Heavy mechanical stream reaches are a subset of the general stream dataset that were then filtered by the ability of machinery to access locations. These were identified by removing reaches with canyon slopes greater than 25 percent and further than 0.25 miles from roads. The canyon slope was used to be in alignment with existing Design Features.

Direct/Indirect Effects Boundaries

A 250-foot buffer on fish species habitat was used for analyzing acreage of direct effects on habitat, as this includes the stream and the adjacent riparian and upland areas that directly influence aquatic habitat and species. For indirect effects, all the analysis area that drains into the fish species habitat was included, as this captures all the potential indirect effects that could occur from any upstream area or activity. For the two gartersnake species a 600-foot buffer was used for analyzing acreage of direct effects because this covers the width of the stream, the width of proposed critical habitat, and the extent of habitat used by the species. For indirect effects, all the analysis area that drains into gartersnake habitat was included, similar to fish species. Percentage of areas affected by direct or indirect effects were calculated using the species analysis areas and the acres or miles proposed within those.

The temporal boundaries for analyzing direct and indirect effects to aquatic species will be 10 to 15 years, given that habitat conditions and species occupancy can change over that timeframe. Direct effects to species are fairly immediate (for example, harm or harassment), while indirect effects occur over a longer period as a result Short-term effects to habitat occur over a timeframe of a year to include a monsoon season and spring flow event. This is based on the assumption that monsoonal rain events (by their nature) increase erosion and sedimentation to aquatic habitats, while spring runoff tends to mobilize sediment downstream. Long-term effects to habitat can last for multiple years or seasons.

Cumulative Effects Boundaries

The spatial boundaries for cumulative effects are the combined areas of direct and indirect effects as described above. Additionally, for some species and some activities it can include private lands within the forest boundaries and lands adjacent to, or upstream and downstream of the project area. Temporal boundaries went back 30 years in time to include any activity with geospatial data on for quantitative analysis. Past management activities that did not have geospatial data were described by general resource area along with potential last effects going back further in time.

Resource Indicators and Measures

Resource measures were identified for those components that could be spatially defined and carried through the analysis of alternatives. Quantitative analyses were conducting for the following resource measures: 1) acres of mechanical thinning, 2) acres of prescribed burning, 3) miles of open ML-1, 4) acres of In Woods Processing Sites, 5) acres of rock pits use and expansion, 6) miles of general stream restoration, and 7) miles of heavy mechanical stream restoration. For some species (for example, sensitive aquatic macroinvertebrates) quantitative evaluation is not possible, so the analyses will be more limited and/or qualitative for some species. Qualitative analyses were used for components that could not be spatially defined such as temporary roads, road relocation, and road decommissioning which are part of both action alternatives. Resource indicators will allow for the comparison between the existing condition and each alternative, and how they may directly or indirectly impact aquatic species and their habitats. Resource elements are larger in context and represented by the resource indicators for analysis. For example, riparian condition represents both aquatic habitat quality and quantity. Measures represent the amount effect to the resource indicators; therefore if acres or miles of measures increase then potential effects to resource indicators may increase. Impacts to indicators will be addressed on the temporal context described previously as well as by direct and indirect impacts. Additional information is provided later for each group of species (such as, fish, frogs, snakes, and invertebrates) analyzed within the effects sections. The resource indicators, elements, and measures are listed in Table 85 below.

Several of the aquatic invertebrate sensitive species were not quantitatively analyzed using the resource indicators and measures. This was not possible primarily due to the species limited or unknown distributions, or no or limited impacts that could result from the proposed actions. GIS maps were reviewed for both alternatives to qualitatively assess the impacts that could occur to these species from the proposed actions (such as, mechanical vegetation treatments and prescribed burning).

Table 85. Resource indicators and measures for assessing effects between alternatives.

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?	Source (LMP S/G; law or policy, BMPs, etc.)?
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition -Short and Mid-term effects negative - Long Term effect neutral or positive 2. Modification of Gartersnake Behavior - Short and Mid-term effects negative - Long Term effect neutral or positive 3. Harm of Gartersnakes - Short term effects negative - Mid and Long Term Effects Neutral 4. Pollutants, Exotic Species and/or Disease - Short, Mid-, and Long Term effects negative	Acres of mechanical thinning treatments	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral or positive 2. Modification of Gartersnake Behavior - Short and Mid-Term effects negative - Long Term effect neutral or positive 3. Harm of Gartersnakes - Short term effects negative - Mid and Long Term Effects Neutral 4. Pollutants, Exotic Species and/or Disease - Short, Mid-, and Long Term effects negative	Acres of Prescribed Burning	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-Term effects negative - Long Term effect neutral or positive 2. Habitat Connectivity - Short and Mid-Term effects negative - Long Term effect neutral or positive 4. Pollutants, Invasive Species - Short, Mid-, and Long Term effects negative	Miles of Open ML-1 and Temporary Roads (Road Density and Location)	Yes	LMP S/G, BMPs

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?	Source (LMP S/G; law or policy, BMPs, etc.)?
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral	Acres of In Woods Processing Sites (IWPS)	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral	Acres of Rock Pits	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short Term effect negative - Mid and Long Term effects neutral or positive	Miles of general stream restoration	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral or positive 2. Instream Aquatic Habitat - Short effects negative - Mid and Long Term effects positive 3. Harm of Fish or Gartersnakes - Short effects negative - Mid and Long Term effect neutral or positive 4. Pollutants, Invasive Species - Short, Mid-, and Long Term effects negative	Miles of heavy mechanical stream restoration	Yes	LMP S/G, BMPs
Habitat Quality and Quantity for Invertebrates	1. Riparian Condition - Short or Mid-Term effects negative - Long Term effects neutral or positive	Qualitative change in sediment delivery or habitat impacts.	Yes	LMP S/G, BMPs

Riparian Condition

Riparian Condition is being used as a surrogate to indicate potential changes in multiple factors that directly influence aquatic and riparian habitat quality and quantity such as sediment load, streamside canopy cover and structure, large woody debris, stream temperature, and changes in peak flows. The current condition of riparian areas indicates their ability and resiliency to provide the ecosystem services listed above in regards to potential direct and indirect impacts. Therefore, riparian areas in good condition would ameliorate potential short term direct impacts to riparian and aquatic habitat whereas areas in poor condition potentially would not. Additionally, resource measures could lead to positive or negative impacts to riparian condition (and thus aquatic or riparian habitat) depending on the timeframe.

Effects on riparian condition will be assessed quantitatively by alternative by comparing predicted direct, indirect, and cumulative effects by major proposed activities within the project area.

Habitat quality and quantity analysis topics include:

- Changes in streamside vegetation cover and structure.
- Changes in sediment delivery to streams altering aquatic habitat and food base.
- Changes in recruitment of large woody debris from riparian areas to streams altering aquatic habitat.
- Changes to stream temperatures as a result of warm water runoff from upland sources or reduced streamside canopy cover.
- Changes to aquatic habitat as a consequence of increased flows caused by removal of upland vegetation resulting in increased storm water runoff.

Environmental Consequences

Alternative 1 – No Action

There would be no direct effects on resource indicators for aquatic species and habitats as a result of the no action alternative, however there would be indirect effects by not moving these resources towards desired conditions. Existing conditions for watersheds would remained degraded and associated loss of habitat would continue which could potentially lead to reductions in populations over time. Overstocked and dense stands within the project area would not be treated, leaving a less healthy, less vigorous, and under productive forest. Encroachment of conifers into riparian areas and wetlands would continue which could decrease shrub and herbaceous ground cover as well as soil hydrologic function (Brown 2019). Current riparian and watershed conditions of Fair or Poor would continue to limit the quality of aquatic habitat and therefore species occupancy. Consequently, Alternative 1 would not be beneficial for riparian condition, aquatic habitat quality or quantity.

Effects Common to Both Action Alternatives

Opening ML-1 Roads

For Alternatives 2 and 3, it is assumed that all 5,682 miles of existing Forest Service roads within the project area would be utilized to provide access for removal of forest projects generated from the proposed mechanical vegetation activities as well as for other activities (Table 86). This includes temporarily opening all existing closed roads (ML-1) to utilize them for the time period that they are needed to provide access. These roads shall be closed upon completion of work and returned to a closed status (ML-1). For further explanation see the transportation specialist report (Rich 2018).

Table 86. Change Miles Of Open Forest Service Roads Treatments For Alternatives 2 & 3 As Compared To Alternative 1 Within The Project Area.

Maintenance Level	Alternative 1 Total Open Road Miles	Alternative 2 & 3 Open Road Miles
1- Basic Custodial Care (closed)	0/ 0	2,076
2 - High Clearance	2,864	2,864
3 - Suitable for Passenger Vehicles	669	669
4 - Moderate Degree of User Comfort	71	71
5 - High Degree of User Comfort	2	2
Total System Roads	3,606	5,682

Opening of ML-1 roads has the potential for direct short and mid-term impacts to aquatic indicators. Direct impacts would result if these activities occur in a species habitat. Both Alternatives are proposing treatments in the habitats of nine fish species and both gartersnakes (Table 87). Increases in miles of open roads ranges from 21 percent to 127percent of the analysis area for direct effects for seven species. The five species that occur downstream of the project have no increases in open roads within their direct effect analysis areas. Increases in road mileage are related to opening ML-1 roads within the direct effects analysis area. Little Colorado spinedace and roundtail chub have the largest increases in mileage; while headwater chub has no change in mileage in relation to direct impacts. Therefore Alternatives 2 and 3 would result in more potential direct impacts by increasing road density than Alternative 1.

Opening ML-1 roads can cause negative short and mid-term impacts to riparian condition, habitat connectivity, individuals, and introduction of pollutants or aquatic invasive species that are similar to new road or trail construction. Direct impacts to riparian condition include reduced riparian vegetation cover or structure, and removal of vegetation. This would be a direct impact to gartersnake critical habitat as well as some aquatic macroinvertebrate species habitat. The number of stream crossings could also be increased causing a direct effect to fish as well as indirect impacts of increased sedimentation from streambank damage. Indirect impacts of increased stream temperature could also occur from reduction in canopy cover within riparian areas. Associated ground disturbance and increased sedimentation delivery to riparian areas and streams is expected to occur short to mid-term until the roads were closed.

Table 87. Change By Species in Miles of Open ML 1 Forest Service Roads for Alternative 2 &3 As Compared To Alternative 1. Percentages Reflect Changes In Acreages Within Species Direct Effects Analysis Areas.

Species*	Alternative 1: Miles of Open Forest Service Roads	Alternative 2 & 3: Miles of Open Forest Service Roads/ Percent Increase
Gila trout	7	9/ 26%
Little Colorado spinedace	18	41/ 121%
Narrow-headed gartersnake	7	9/ 29%
Northern Mexican gartersnake	4	5/ 25%
Desert Sucker	23	45/ 90%
Sonoran Sucker	6	7/ 21%
Little Colorado sucker	18	40/ 114%
Headwater chub	13	13/ 0%
Roundtail chub	5	12/ 127%

* Species with analysis areas that did not overlap with miles of open ML 1 Forest Service roads are not listed.

Indirect impacts to riparian condition and introduction of pollutants could occur from opening ML-1 roads in upper watersheds for all analyzed species (Table 88). Increases in miles of open roads range from 4 percent to 115 percent. Narrow-headed gartersnake and Sonoran sucker have the largest increases in road mileage. Gila chub and the four species in Fossil Creek (Gila topminnow, Loach minnow, Razorback sucker, and Spikedace) have the lowest increases in open road mileage since only a portion of those subwatersheds are within the project area. Alternatives 2 and 3 would have more direct impacts from opening ML-1 roads within species action areas than Alternative 1.

Table 88. Change By Species In Miles Of Open Forest Service Roads For Alternative 2 &3 As Compared To Alternative 1. Percentages Reflect Changes In Acreages Within Species Analysis Areas. These Are Considered Indirect Impacts.

Species	Alternative 1: Miles of Open Forest Service Roads	Alternative 2 & 3: Miles of Open Forest Service Roads/ Percent Increase
Gila trout	232	324/ 40%
Gila chub*	61	63/ 4%
Gila topminnow*	63	70/ 11%
Little Colorado spinedace	917	1768/ 93%
Loach minnow*	63	70/ 11%
Razorback sucker*	63	70/ 11%
Spikedace*	63	70/ 11%
Narrow-headed gartersnake	170	372/ 119%
Northern Mexican gartersnake	86	142/ 65%
Desert Sucker	1034	1439/ 39%
Sonoran Sucker	112	240/ 115%
Little Colorado sucker	796	1412/ 77%
Headwater chub	354	438/ 24%
Roundtail chub	475	907/ 91%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Indirect impacts of opening ML-1 roads in the upper watershed could occur to riparian condition and by introduction of pollutants or invasive aquatic species. In general, roads compact soils and reduce infiltration of water leading to increased erosion and runoff. They increase the drainage network to riparian areas and streams and connect these areas to the uplands by altering surface water pathways. This converts dispersed surface runoff and sediment filtering through a riparian area to direct deliveries of accumulated runoff and sediment. Pollutants and aquatic invasive species can be transferred to aquatic systems from machinery or vehicles. Leaking fuels or lubricants can be transferred to aquatic systems from vehicles, machinery, or fuel storage areas. Aquatic invasive species can similarly be transferred from an infected water body to an uninfected waterbody through driving.

Roads not only impact perennial and intermittent streams where aquatic species and riparian areas are present, but influence these habitats where they are located adjacent to or cross ephemeral channels in the watershed. Ephemeral streams indirectly support aquatic populations by providing required nutrients and other materials to the perennial streams (Levick et al. 2008).

Potential indirect effects are expected to vary based on current riparian condition. Species with riparian conditions that are currently poor are expected to have a higher level of indirect effects from sedimentation and peak flows. They are currently not capturing or processing sediment, indicating more could potentially reach stream from direct delivery. Stream energy from increased peak flows and concentrated flows would not be dissipated potentially altering instream habitats. Riparian areas that are fair or good would be capable of processing some levels of sediment and peak flows; however, the concentrated delivery from roads would still have negative impacts over the mid-term timeframe until they were closed.

Opening ML-1 roads would also increase road density during the timeframe that proposed project activities are occurring. This would negatively impact the Roads and Trails indicator for Watershed

Condition Framework in the interim impacting one of the five factors associated with aquatic species and habitats.

Design features for roads are expected to reduce some of the potential impacts to aquatic species and habitats. Minimizing disturbance of existing vegetation in ditches and at stream crossings during maintenance. New cross drains would discharge to stable areas where the outflow would quickly infiltrate the soil and not develop a channel to a stream. Whenever possible, use existing stream crossings unless a new crossing would result in less resource damage.

In Woods Processing Sites (IWPS) and Biomass Storage

No direct effects to any aquatic indicators or species are expected to occur from IWPS (Table 89). None of the proposed IWPS occur within 0.4 mile of occupied or suitable habitat. In addition, they occur within conifer ERUs (Ponderosa Pine, Ponderosa Pine-Evergreen Oak, Mixed Conifer w/ Aspen, and Mixed Conifer) and not within any riparian areas.

Indirect impacts from IWPS have the potential to occur to seven of the species based on their action areas. Two species (Gila trout and Sonoran Sucker) would have no indirect impacts. Acreages of IWPS range from 3.1 to 57.4 acres for both gartersnakes and desert sucker, respectively). Negative indirect impacts to riparian condition in the form of sedimentation are possible, but limited based on less than 0.5 percent of any species action area being impacted. In Woods Processing Sites would also have limited negative impacts to aquatic macroinvertebrates based on the very low percentage of IWPS acreage in any of the subwatersheds. For California floater, only two watersheds have the potential for any indirect impacts, with a total of approximately 72 acres of IWPS within those watersheds. The other aquatic macroinvertebrates share similar stream and riparian habitats with fish and gartersnakes; therefore, overall acreages of IWPS are still below 1 percent combined.

The Apache-Sitgreaves National Forests do not have any of the identified IWPS listed above; instead they would allow biomass (needles, tree tops and branches up to 5 inches) waiting to be processed to remain on forest during mechanical operations for up to 90 days. The timeframe allowed may be shortened based on conditions such as fire risk preparedness levels.

Allowing biomass to stay on the Apache-Sitgreaves National Forests should not directly impact aquatic species or habitats, but could have indirect impacts. Piling of any kind is not allowed within Aquatic Management Zones; therefore this action should not have any direct effects. Indirect effects could include soil disturbance from machinery moving material to and from the piles as well as hauling. Soil disturbance can lead to erosion and contribute fine sediment to streams negatively impacting aquatic habitat, species, and water quality; particularly eggs and early life stages that occur on or within substrate and aquatic macroinvertebrate community structure. Habitat can be negatively impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Excessive fine sediment can impact macroinvertebrate prey bases and other food sources such as algae.

Similarly, leaving biomass should not directly impact sensitive invertebrates, but could have indirect impacts. For aquatic invertebrate species, increased fine sedimentation can lead to physical effects as well as changes in habitat and food availability and quantity. Physical effects include abrasion, clogging of gills and filter-feeding apparatus, burial, and changes in substrate composition (Jones et al. 2012). Bivalve mollusks, such as California floater, are capable of expelling unwanted particles from their gulls but can also expend more energy doing so than is gain from feeding. Filter feeding caddisfly larvae are generally not present in streams receiving high inputs of fine sediment. Burial presents difficulties for sedentary animals, such as mollusks, but can affect motile invertebrates where rates of deposition are high.

When inputs of fine sediment are increased in watersheds, interstices between large particles become filled which reduces refugia from predators or high-flow events. Most aquatic invertebrates are strongly associated with substrate composition; therefore increased fine sediment can alter habitat availability. Increased sedimentation can also decrease the nutritional quality of periphyton (the film of attaches algae, fungi, bacteria, organic matter, and sedimented material found on the surface of stones). Some caddisflies, stoneflies, and mayflies are particularly impacted by sedimentation (Harrison et al. 2007).

Table 89. Change By Species In The Acres Of In Woods Processing Sites For Alternatives 2 & 3 as Compared To Alternative1. Percentages Reflect Changes In Acreages Within Species Analysis Areas. These Are Considered Indirect Impacts.

Species*	Alternative 1: Acres of In Woods Processing	Alternatives 2 & 3: Acre of In Woods Processing/ Percentage of Direct Effects Area
Little Colorado spinedace	0	25.7/ 0.01%
Narrow-headed gartersnake	0	3.1/ 0%
Northern Mexican gartersnake	0	3.1/ 0.01%
Desert Sucker	0	57.4/ 0.02%
Little Colorado sucker	0	25.7/ 0.01%
Headwater chub	0	8.5/ 0.01%
Roundtail chub	0	38.5/ 0.02%

* Species with analysis areas that did not overlap with In Woods Processing Sites are not listed.

In Woods Processing Sites could have negative short and mid-term indirect impacts to riparian condition. In general, soils can be compacted and water infiltration reduced leading to increased runoff and sediment delivery to riparian areas and streams. This can reduce riparian condition, aquatic habitat quality and quantity depending on its current condition.

Potential indirect effects are expected to vary based on current riparian condition. Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more would reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently functioning at risk, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Upper Fossil Creek is functioning properly. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows. That particular watershed also has less than 5 percent of its overall area within the project area inherently decreasing overall effects.

For those species with impaired or functioning at risk riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Potential indirect impacts of IWPS and biomass storage could occur short and mid-term. However, given the low overall acreage within species action areas, indirect effects are considered to be minimal.

Rock Pit Development or Expansion

No direct effects to any aquatic species or habitats are expected to occur from Rock Pit use or expansion. None of the proposed rock pits occur within ½ mile of occupied or suitable habitat. In addition, they occur within conifer ERUs (Ponderosa Pine, Mixed Conifer with Aspen, and Mixed Conifer) which are not utilized by sensitive invertebrate species, therefore no direct impacts would occur.

Indirect impacts from rock pit use and expansion within the upper watershed have the potential to occur to six of the species. Three species (Gila trout, Sonoran Sucker, and Desert Sucker) would have no indirect impacts. Acreages of rock pits within species action areas range from 4.6 to 200.6 acres (Table 90). Little Colorado spinedace and sucker have higher acreages of Rock Pits versus all other species. Overall, potential negative impacts are limited based on less than 1 percent of any species action area being impacted.

Indirect impacts to aquatic macroinvertebrates could occur from Rock Pit use and expansion similar to fish and gartersnakes. For California floater, only Upper Clear Creek watershed has any rock pits, approximately 177 acres or less than 1 percent of that 5th Code watershed.

Negative indirect effects from rock pits could potentially occur to riparian condition. Expansion of the pits would result in removal of some additional vegetation and could lead to some increases in erosion and sedimentation. However, design features limiting vegetation removal, erosion control, and reclamation are expected to reduce the potential for any impacts to riparian condition.

Table 90. Change By Species In The Acres Of Existing Rock Pits Sites And Their Expansion For Alternatives 2 & 3 As Compared To Alternative 1. Percentages Reflect Changes In Acreages Within Species Analysis Areas. These Are Considered Indirect Impacts.

Species*	Alternative 1: Acres of Rock Pits	Alternative 2: Acre of Rock Pits/ Percentage of Action Area
Little Colorado spinedace	20	200/ 0.07%
Narrow-headed gartersnake	0	5/ 0.01%
Northern Mexican gartersnake	0	5/ 0.01%
Desert Sucker	0	5/ 0.00%
Little Colorado sucker	0	103/ 0.05%
Headwater chub	0	5/ 0%

* Species with analysis areas that did not overlap with Rock Pits are not listed.

Stream, Riparian, Wet Meadow, and Spring Restoration

Proposed stream restoration was categorized as either general stream treatments or heavy mechanical stream treatments based on the methods of implementation. General stream treatments are described as any methods in the AWFTA that do not involve heavy mechanical equipment in or near a stream. Examples would include methods such as: fencing, planting, tools for improving spring outflows, and Zuni bowls or one rock dams as described in the AWFTA. Heavy mechanical stream treatments are reflective of treatments such as, but not limited to, channel reconstruction, channel realignment, and floodplain reconnection. The majority of the heavy mechanical treatments are described in appendix C under the heading “Tools for improving the form and function of stream channels and floodplains”.

General stream treatments could have direct and indirect impacts to aquatic indicators. Miles of proposed treatments range from 5 miles for Sonoran sucker to 179 miles for Little Colorado spinedace (Table 91). No direct or indirect impacts are expected to occur for 7 species as no treatments are proposed within their habitats, this includes both gartersnakes. The proposed activities are intended to enhance riparian and aquatic conditions at the site scale. All of these actions may result in some degree of short and mid-term negative effects to aquatic species and their habitats.

Direct effects to riparian condition would include ground disturbance reducing riparian vegetation cover or structure short to mid-term. Ground disturbance would lead to indirect impacts increased sedimentation during project implementation. These impacts are considered short-term (a few weeks) and sediment should be moved downstream during the first high stream flow. Beneficial impacts of general stream treatments can be immediate and long-term. Stabilizing headcuts has an immediate impact of stabilizing a stream and improving fish passage upstream. Riparian planting increases bank stability, shade, and organic matter inputs to streams improving stream habitat.

Table 91. Change by Species in the Miles of General and Heavy Mechanical Stream Restoration for Alternatives 2 & 3 As Compared To Alternative 1. Percentages Reflect Changes In Acreages Within Species Analysis Areas. These Are Considered Direct And Indirect Impacts.

Species*	Alternative 1	Alternatives 2 & 3: General Stream Treatment Miles/ Percentage of Action Area.	Alternatives 2 & 3: Heavy Mechanical Stream Treatment Miles/ Percentage of Project Area
Gila trout	0	7/ 22%	4/ 13%
Little Colorado spinedace	0	179/ 96%	24/ 13%
Desert Sucker	0	51/ 48%	18/ 17%
Sonoran Sucker	0	5/ 37%	3/ 26%
Little Colorado sucker	0	123/ 84%	14/ 10%
Headwater chub	0	9/ 19%	7/ 14%
Roundtail chub	0	23/ 66%	3/ 10%

* Species with analysis areas that did not overlap with stream restoration are not listed.

Heavy mechanical stream treatments could have negative direct and indirect impacts to aquatic indicators. These treatments inherently include disturbance to streams, their floodplains, and associated riparian areas in order to improve form and function. Miles of proposed treatments range from 3 to 24 miles, which encompasses 10 percent to 26 percent of occupied habitats. No direct and indirect impacts are expected to occur for 7 species as no treatments and proposed within their habitats, this includes both gartersnakes. Sonoran sucker and Desert sucker have the highest percentage of occupied/suitable habitat within proposed heavy mechanical stream treatments.

Short-term direct impacts of heavy mechanical stream restoration could occur to individuals, while indirect impacts to riparian condition, introduction of contaminants, and spreading of aquatic invasive species or disease could occur during project implementation.

Direct impacts in the form of mortality could occur from heavy machinery in and around streams, springs and wetlands. These are considered short-term effects as they would only occur while heavy equipment was operating. Conservation measures to look for and move gartersnakes, remove and isolate fish from instream construction zones, and in water work periods are expected minimize the potential for direct impacts. In water, work periods would be determined on a project specific basis and jointly by Forest Service, U.S. Fish and Wildlife Service and Arizona Game and Fish Department due to the overlapping of federally listed and sensitive species.

Short-term negative impacts of temporarily restricting habitat or habitat access (displacement) could occur during project implementation. Coffer dams and bypass systems associated with heavy mechanical restoration activities may temporarily block (few weeks) fish movement up and/or downstream through the construction area. Up and downstream fish movement is provided by ditch bypass systems, downstream movement is provided with plastic-culvert bypass systems, and no fish movement is provided with pump bypass systems. Headcuts and existing structures to be repaired may serve as exiting fish-passage barriers; therefore, coffer dams and diversion structures may not be any more of a barrier than the pre-restoration baseline.

Riparian condition could be negatively impacted short-term inputs of increased sedimentation from instream structure placement, opening of side channels, road crossing treatments, and other projects inside or near the bankfull channel. The sediment plume from activities would be most concentrated in the immediate project vicinity and should dissipate throughout the stream channel within a few hours. The amount, extent, and duration of fine sediment inputs and turbidity relate to the following: the type and duration of heavy machinery used within or near a bankfull channel; soil type; the amount of soil disturbance; whether restoration is in or out of the wetted channel; the sensitivity of the channel banks to erosion and other disturbances; the amount of time it takes for disturbed areas to revegetate and stabilize; and the probability of precipitation events before disturbed areas are re-vegetated or stabilized.

The increased stream turbidity may deposit fine coats of sediment on channel substrate a short distance downstream, encourage fish and other aquatic species to move downstream, and alter fish behavior patterns for a short time. It is anticipated that all project related sediment would be flushed out during the first fall/winter/spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term negative impacts to substrate are not expected.

Contaminants and aquatic invasive species or diseases could be introduced into the stream from large equipment causing negative indirect impacts to aquatic species. Chemical transport could be direct into streams from equipment or from storm water runoff through or over soil. Pollutants alter soil chemistry, may be absorbed by plants, can affect stream ecosystems, where they are dispersed and diluted over considerable distances. Typical water-quality responses to pollutants include altered levels of heavy metals, salinity, turbidity, and dissolved oxygen. These water quality changes can be sporadic and localized due to fluctuations in water quantity. Aquatic invasive species or diseases could similarly be introduced to streams or waterbodies. Best management practices and conservation measures requiring cleaning equipment, checking for leaks, storage of fuels, and staging areas for equipment out of AMZs minimizes the likelihood of either occurring.

Benefits from heavy mechanical stream restoration can be immediate and long-term by improving or restoring riparian condition via one of the following: stream structure/complexity, stream sinuosity and length, bank stability, floodplain connectivity. Such results would promote conditions that maintain or decrease stream temperature, reduce turbidity (via stable banks, improved sediment retention through increased channel structure, riparian areas, and floodplains), and improved nutrient input (via increases riparian organic input sources) and retention (via increased channel structure, sinuosity, and floodplain areas). It is anticipated that the project related sediment would be flushed out during the first spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term sediment impacts to sediment and turbidity are not expected.

Human constructed or caused physical barriers within the stream channel such as culverts and headcuts can impair sediment and debris transport, migration routes, life history patterns, and population viability.

First and second order streams are the sources of water, nutrients, wood, and other vegetative material for streams inhabited by fish and other aquatic organisms. Fish Passage Culvert Projects, Headcut stabilization and Associated Fish Passage, and Legacy Structure Removal treatments would result in benefits such as uninhibited stream access for migrating and rearing fish, restored or improved continuous paths for wood, nutrients, sediments, and other vegetative material essential for quality fish habitat.

Upland soil restoration structures (for example, Zuni bowls or native rock check dams) may be used to address site specific erosion/channelization resource issues within project watersheds. The number that may be installed would vary based on watershed needs. These structures would have a long term benefit of reducing erosion and sedimentation to stream by holding and stabilizing soils in the uplands and improving hydrologic condition and function. Riparian and rare plant planting and enclosures to protect existing or planted areas could occur where site-specific needs are identified in riparian areas, wet meadows, springs, and uplands areas such as where aspen or big-toothed maple occur. Riparian planting and enclosures along streams can improve bank stability, stream shading and aquatic habitat.

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles are strongly associated with streams and riparian areas. Based on the biology and ecology of these four groups of species, stream and watershed restoration in accordance with the AWFTA could have negative direct and indirect impacts. Direct impacts to individuals and their habitats could occur short-term during project implementation. General stream treatments would have a low potential for direct and indirect impacts to these sensitive species given the methods included (for example, fencing or planting). Heavy mechanical stream treatments have the potential for more direct effects as they include short-term habitat alteration in streams and riparian areas that could also impact individuals. Indirect effects of sedimentation from the AWFTA restoration treatments would last as long as the first few flushing flow events. Beneficial effects would occur from improved stream habitats and riparian vegetation long term.

Nokomis Fritillary is a sensitive species that utilizes meadows, seeps, and boggy streamside vegetation. General stream treatments would have a low potential for direct or indirect impacts to the species. Heavy mechanical stream treatments could have direct and indirect impacts. Short-term direct impacts to individuals and their habitat could occur during implementation. Indirect effects of habitat alteration would last until vegetation was restored or had regrown that supports the species. Beneficial effects would occur from improved stream-riparian interaction and riparian habitat.

For California Floater, general stream restoration treatments would have a low potential for direct or indirect impacts. Fencing across streams could directly impact the species, but is unlikely. Indirect impacts of sedimentation from these methods would also be considered negligible. Heavy mechanical stream treatments are proposed in Upper Clear Creek (49 miles) and West Clear Creek (2.9 miles) where the species historically or currently occurs. Short-term direct impacts would occur during implementation of instream treatments that could also impact individuals. Indirect impacts of sedimentation are expected to persist until first few flushing flows mobilize any sedimentation downstream. Beneficial effects would occur from improved stream habitats long term.

For all sensitive aquatic macroinvertebrates, streams and riparian areas could have short-term negative indirect impacts from proposed stream restoration as part of Alternatives 2 and 3. Short-term indirect effects of heavy mechanical stream restoration include increased sedimentation and turbidity, introduction of contaminants, and spreading of aquatic invasive species or disease during project implementation. Project level best management practices and mitigations would minimize the potential for introduction of contaminants or spread of aquatic invasive species or disease.

Road Relocation and Decommissioning

Road relocation and decommissioning include restoring a road surface to a more natural state. Short-term negative impacts to individuals and riparian condition would be similar to those discussed above for aquatic restoration. Direct impacts to individuals could occur for any work within species habitats. Riparian condition could be negatively impacted short to mid-term by increased sediment delivery until vegetation reestablished.

However, long term benefits of reducing road density have a cascade of effects: improved riparian condition from reduction in runoff and sedimentation, fewer roads crossings, and the ability for riparian vegetation to be restored, and decreased mortality or disturbance of species. Road density is a major factor in the current condition of most subwatersheds with aquatic species in the project area. Reducing road density by decommissioning roads could help improve that particular Watershed Condition Framework indicator. Relocating roads does not reduce overall road density, but can alleviate direct versus indirect impacts, particularly if move a road further from a stream or riparian area.

Design features for road relocation are expected to reduce some of the potential impacts. Relocated roads should be constructed in a manner that does not hydrologically connect them to streams to extent practicable. They would also have sufficient drainage features to maintain the integrity of the travel, thereby reducing erosion and sedimentation. New cross drains would discharge to stable areas where the outflow would quickly infiltrate the soil and not develop a channel to a stream. When feasible, relocate roads out of drainage bottoms to upland locations; if this is not possible rock armor outfall of drainage features to dissipate water energy. Contaminants and aquatic invasive species or diseases could be introduced into the stream from large equipment causing negative indirect impacts to aquatic species. Chemical transport could be direct into streams from equipment or from storm water runoff through or over soil. Pollutants alter soil chemistry, may be absorbed by plants, can affect stream ecosystems, where they are dispersed and diluted over considerable distances. Typical water-quality responses to pollutants include altered levels of heavy metals, salinity, turbidity, and dissolved oxygen. These water quality changes can be sporadic and localized due to fluctuations in water quantity. Aquatic invasive species or diseases could similarly be introduced to streams or waterbodies. Best management practices and conservation measures requiring cleaning equipment, checking for leaks, storage of fuels, and staging areas for equipment of AMZs minimizes or precludes the likelihood of either occurring.

Direct and Indirect Effects - Alternatives 2 and 3

Mechanical Vegetation Treatments

For Alternatives 2 and 3, acres of mechanical vegetation treatments has the potential for negative short and mid-term impacts to riparian condition and individuals. Direct negative short term impacts would result if these activities occur in a species habitat from actions such as yarding, skidding, or harm to gartersnakes during mechanical operations. Both alternatives are proposing treatments within the habitats of seven fish species and both gartersnakes. For Alternative 2, increases in acreages of treatments ranges from 203 to 3,891 acres which equates to 1 percent to 100 percent of the analysis area for direct effects for those species. Whereas, increased acreage of treatments ranges from 566 to 4,881 which equates to 19 percent to 100 percent of the direct effects analysis area for Alternative 3. Five fish species would not be directly impacted by mechanical vegetation treatments under Alternatives 2 and 3 because they do not occur within the project area. Table 92 displays this information for each species.

Table 92. Change by species in the acres of mechanical vegetation treatments for Alternative 2 and 3 as compared to Alternative 1. Percentages reflect increases in acreage within direct effects analysis areas for species.

Species*	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 2: Acre of Mechanical Vegetation Treatment Acres/ Percentage of Direct Effects Area	Alternative 3: Acre of Mechanical Vegetation Treatment Acres/ Percentage of Direct Effects Area
Gila trout	0	1,398/ 52%	1,319/ 49%
Little Colorado spinedace	0	5,133/38%	4,881/ 36%
Little Colorado spinedace CH	0	1,496/ 40%	1,496/ 40%
Narrow-headed gartersnake & CH	0	2,266/ 93%	2,040/ 92%
Northern Mexican gartersnake & CH	0	1,249/ 100%	1,196/ 100%
Desert Sucker	0	3,891/ 29%	3,744/ 28%
Sonoran Sucker	0	573/ 39%	566/ 38%
Little Colorado sucker	0	3,292/ 25%	2,986/ 23%
Headwater chub	0	1,939/ 55%	1,806/ 52%
Roundtail chub	0	1,581/ 26%	1,180/ 19%

* Species with analysis areas that did not overlap with mechanical vegetation treatments are not listed.

Mechanical vegetation treatments can negatively impact riparian condition short to mid-term when they occur within the direct effects analysis area. Direct impacts of reduced riparian vegetation cover or structure could occur by removal of trees or crushed by machinery. These are also direct impacts to gartersnake critical habitat as well as habitat for some aquatic macroinvertebrates species. Indirect impacts of increased stream temperature from loss of canopy cover could occur, but should be limited based on design features associated with providing for and protection of existing stream shade. Indirect impacts of ground disturbance and increased sediment delivery to streams is expected to occur short to mid-term until ground cover is reestablished. Stream banks can be also be damaged, which are primary constituent element for some fish, however design features for mechanical vegetation treatments including restrictions for skid trails and yarding within riparian areas as well as protecting stream banks would minimize potential impacts.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore direct and indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. Riparian condition for the remaining species is functioning at risk, therefore direct and indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and functioning at some level.

Impacts to individuals in the form of harm or modification of behavior could also occur short to mid-term. Mechanical vegetation treatments within gartersnake habitat could result in harm of individuals as a direct effect. Indirectly, gartersnakes may avoid or move out of these areas while work is occurring causing displacement or disruption of social and feeding behavior. These indirect effects have the potential to reduce the health or reproductive capability of individuals.

Long term, mechanical vegetation treatments could have a neutral or positive effect on aquatic indicators. Riparian condition could be improved by removing encroachment and restoring streamside vegetation. Conifers can impede the growth the riparian woody and herbaceous species; therefore it is expected they would increase in cover and structure. This would provide for large woody debris over time as well as decreasing sediment delivery and peak flows. Impacts to individuals would cease once activities were completed and therefore have a neutral effect long term.

For both action alternatives, increased acres of mechanical vegetation treatments also has the potential for indirect occur short to mid-term impacts riparian condition from treatments in the upper watershed as compared to Alternative 1. These are indirect impacts that can occur within a species action area (such as, project watershed area that drains into a species occupied habitat) by changes in the uplands and on tributaries and drainages. Increases in percent of action areas treated under Alternative 2 range from 54 percent to 94 percent and from 11 percent to 68 percent for Alternative 3. Table 93 displays these species habitats as compared to the existing condition (Alternative 1).

Under Alternative 3, five species have increases of 11 percent, but it is important to note the overall acreage is comparatively small due to approximately half of that watershed occurring within the project area.

Table 93. Change by species in acres of mechanical vegetation treatments for Alternative 2 and 3 as compared to Alternative 1. Percentages reflect increases in acreage within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 2: Mechanical Vegetation Treatment Acres/ Percentage of Action Area	Alternative 3: Mechanical Vegetation Treatment Acres/ Percentage of Action Area
Gila trout	0	89,699/ 81%	71,921/ 65%
Gila chub*	0	12,325/ 57%	2,489/ 11%
Gila topminnow*	0	11,628/ 94%	1,327/ 11%
Little Colorado spinedace	0	150,627/ 55%	121,836/ 44%
Little Colorado spinedace Critical Habitat	0	25,612/ 43%	19,210/ 32%
Loach minnow*	0	11,628/ 94%	1,327/ 11%
Razorback sucker*	0	11,628/ 94%	1,327/ 11%
Spikedace*	0	11,628/ 94%	1,327/ 11%
Narrow-headed gartersnake and Critical Habitat	0	65, 851/ 74%	41,711/ 47%
Northern Mexican gartersnake and Critical Habitat	0	38,171/ 79%	31,051/ 64%
Desert Sucker	0	207,340/ 65%	169,502/ 54%
Sonoran Sucker	0	37,108/ 71%	30,623/ 59%
Little Colorado sucker	0	121,732/ 54%	95,251/ 42%
Headwater chub	0	117,548/ 83%	97,295/ 68%
Roundtail chub	0	122,186/ 76%	82,835/ 52%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Mechanical vegetation treatments in uplands can indirectly impact riparian condition short to mid-term from increased sediment delivery and peak flows via removal of vegetation and ground disturbance. Soils can be compacted and water infiltration reduced from landings and skid trails leading to increased overland flow and erosion. Yarding and skidding can redirect water onto areas more likely to erode than natural channels. In turn, increased sedimentation and peak flows can occur reducing riparian condition, aquatic habitat quality and quantity.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently poor, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more would reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore likely unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently fair, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Upper Fossil Creek is good. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows.

For those species with poor or fair riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Design features related to mechanical vegetation treatments are expected to minimize the potential effects described above. The project includes spreading treatments in time and space within a watershed as well as for skid trails, yarding, and landings are expected to reduce these impacts.

Pollutants in the form of fuels and lubricants have the potential to be introduced into aquatic systems from staging areas and equipment. Spills and leaks can introduce pollutants to soils and then to streams and riparian areas reducing riparian condition and habitat quality. Design features for storm water protections plans, staging areas, fuel storage and checking equipment for leaks minimizes the potential for introduction of pollutants.

Long term, mechanical vegetation treatments are expected to improve overall watershed condition as well as riparian condition. Moving forests towards desired conditions of more a healthy, resilient state would provide for improved watershed function over time. It would also reduce the risk of uncharacteristic wildfire which can greatly impact all resource indicators and reduce aquatic habitat quality, quantity and populations. Alternative 2 would have more long term improvements to riparian condition than Alternatives 1 and 3 due to the increased overall acreage.

Prescribed Burning

For the action alternative, acres of prescribed burning has the potential for negative short and mid-term impacts to riparian condition and harm to individuals. Direct short term impacts would result if these activities occur within species habitat from fire lines, removal or reduction of vegetation due to burning or harm to gartersnakes. Alternatives 2 and 3 are proposing treatments in the habitats of seven fish species and both gartersnakes (Table 94). For Alternative 2, increases in acreage of treatments ranges from 0 to 9,405 which equates to 0 percent to 100 percent of the analysis area for direct effects for those species. Whereas for Alternative 3, increased acreage of treatments ranges from 623 to 8,819 which equates to 24 percent to 100 percent of the analysis area for direct effects for those species. Five fish species would not be directly impacted by prescribed burning under Alternatives 2 and 3 because the stream does not occur within the project boundary.

Prescribed burning can negatively impact riparian condition short to mid-term when it occurs in the direct effects analysis area. Direct impacts of reduced riparian vegetation cover or structure and decreases in large wood recruitment could occur from burning. Decreases in willows and other shrubby species reduces hiding and thermal cover for gartersnakes. This would be a direct alteration of gartersnake critical habitat as well as potentially impacting some aquatic macroinvertebrate species. This reduction is only expected to occur until vegetation recovers. Reduction in canopy cover also reduces stream shading and can increase stream temperatures. It also reduces organic matter inputs to streams which can alter food webs and prey base for fish and gartersnakes. Indirect impacts of increased stream temperature from loss of canopy cover could also occur, but should be limited based on design features associated with limiting high burn severity (mortality) and ignitions within riparian areas.

As discussed for mechanical vegetation treatments, riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently poor, therefore direct and indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. They already lack adequate streamside cover and structure, therefore those factors could be more susceptible to impacts. Riparian condition for the remaining species is fair, therefore direct and indirect effects are expected to be less as they have more cover and structure. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and functioning at some level. Species with good riparian condition are expected to have even less potential direct effects, particularly given design features for prescribed burning.

Long term effects of prescribed burning are expected to be positive for riparian condition. Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future. Large woody debris recruitment and streamside cover or structure can also improve with prescribed fire. Fire plays an important role in maintaining heterogeneity in riparian and aquatic systems that has been excluded similar to surrounding uplands (Gresswell 1999); therefore, restoring the fire regime would have some benefits to riparian condition.

Impacts to individual gartersnakes in the form of mortality or modification of behavior could also occur short to mid-term. Mortality could occur during prescribed burning; however, gartersnakes are mobile and design features of no burn piles within their habitat is expected to reduce that potential. While gartersnakes are more susceptible to exposure during a prescribed fire, it is more likely that harm or displacement would occur until the burns were completed. Long term impacts to individuals would be neutral or potentially positive if habitat improved and similarly increased social or feeding behavior.

Table 94. Affected acres by species and the percent of change in the acres of prescribed burning for Alternative 2 and 3 as compared to Alternative 1. Percentages reflect changes in acreages within species direct effects analysis areas.

Species*	Alternative 1: Acres of Prescribed burning	Alternative 2: Acres of Prescribed Burning/ Percent of Direct Effect Area	Alternative 3: Acres of Prescribed Burning/ Percent of Direct Effect Area
Gila trout	0	1,541/ 57%	1,462/ 54%
Little Colorado spinedace	0	9,405/ 70%	8,819/ 65%
Little Colorado spinedace Critical Habitat		2,114/ 57%	2,114/ 57%
Narrow-headed gartersnake and proposed Critical Habitat	0	2,437/ 100%	2,211/ 100%
Northern Mexican gartersnake and proposed Critical Habitat	0	1,249/ 100%	1,196/ 100%
Desert Sucker	0	4,542/ 34%	4,395/ 33%
Sonoran Sucker	0	630/ 43%	623/ 42%
Little Colorado sucker	0	6,734/ 52%	6,244/ 48%
Headwater chub	0	2,090/ 60%	1,957/ 56%
Roundtail chub	0	1,900/ 31%	1,470/ 24%

* Species with analysis areas that did not overlap with prescribed burning are not listed.

Prescribed burning in uplands can indirectly impact riparian condition short to mid-term from increased sediment delivery and peak flows for all analyzed species. The increases in percentage of action areas treated range from 57 percent to 97 percent for Alternative 2 and from 11 percent to 75 percent for Alternative 3. Table 95 displays these species habitats as compared to the existing condition (Alternative 1). However, while the five species (denoted with an asterisk) show increases in acres treated, it is important to note the overall acreage is small. This is due to less than half of their overall watershed occurring within the project. Therefore, while the percent increase is large the overall potential acres of impacts are much smaller than all other species. Overall impacts would be highest for both Gila Trout and Headwater Chub as most of their action area is encompassed and lowest for Gila Chub and the four species that occur in Fossil Creek.

Prescribed burning can indirectly impact riparian condition short to mid-term from increased sediment delivery and peak flows. Loss of ground cover from burning can increase erosion and overland flow which leads to increased sedimentation and peak flows. This could reduce riparian condition, aquatic habitat quality and quantity. However, these impacts are only expected to occur until ground cover vegetation recovers and has the ability to dissipate flows and trap sediment. Design features for extent of high burn severity as well as spatial and temporal spacing of activities within a watershed are expected to minimize potential impacts.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently poor, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more could potentially reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently fair, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Fossil Creek is good. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows. Overall acres of treatment for Gila chub, loach minnow, spikedace, razorback sucker, and Gila topminnow are less than half of the watersheds in which they occur further reducing potential indirect effects. Additionally, prescribed burning would only occur in the upper watershed within the project area further decreasing potential indirect impacts.

For those species with poor or fair riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Potential reductions in fish prey base could also indirectly impact gartersnakes. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Long term effects of prescribed burning in the upper watersheds are expected to be positive for riparian condition. Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future that can impact entire watersheds and have long lasting negative impacts on riparian condition, aquatic habitat quality and quantity, as well as populations of species.

Table 95. Change by species in the acres of prescribed burning for Alternative 2 and 3 as compared to Alternative 1. Percentages reflect changes in acreages within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Acres of Prescribed burning	Alternative 2: Acres of Prescribed Burning/ Percentage of Action Area	Alternative 3: Acres of Prescribed Burning/ Percentage of Action Area
Gila trout	0	97,258/ 88%	79,480/ 72%
Gila chub*	0	12,328/ 57%	2,492/ 12%
Gila topminnow*	0	11,990/ 97%	1,328/ 11%
Little Colorado spinedace	0	172,583/ 63%	140,659/ 51%
Little Colorado spinedace Critical Habitat	0	28, 944/ 49%	22,291/ 38%
Loach minnow*	0	11,990/ 97%	1,328/ 11%
Razorback sucker*	0	11,990/ 97%	1,328/ 11%
Spikedace*	0	11,990/ 97%	1,328/ 11%
Narrow-headed gartersnake and proposed Critical Habitat	0	73,184/ 82%	47/315/ 53%
Northern Mexican gartersnake and proposed Critical Habitat	0	41,628/ 86%	34,621/ 72%
Desert Sucker	0	230,200/ 73%	190,190/ 60%
Sonoran Sucker	0	41,398/ 79%	34,202/ 66%
Little Colorado sucker	0	141,334/ 63%	113,047/ 50%
Headwater chub	0	127,710/ 90%	106,923/ 75%
Roundtail chub	0	135,344/ 84%	94,401/ 59%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Temporary Roads

Temporary roads can cause negative impacts to riparian condition, habitat connectivity, as well as potentially introduce pollutants and or aquatic invasive species. Under Alternative 2, up to 330 miles of temporary roads could be utilized to facilitate mechanical vegetation activities. While for Alternative 3, up to 170 miles roads could be utilized These may be new locations and/or non-system roads and they would be decommissioned when work is completed in the area that the access.

Temporary roads can have the potential for direct short and mid-term impacts to aquatic indicators, but both action alternatives do not allow temporary roads within AMZs thereby removing the potential for direct effects.

Indirect negative impacts of opening temporary roads in the upper watershed could also occur to riparian condition. In general, roads compact soils and reduce infiltration of water leading to increased erosion and runoff. They increase the drainage network to riparian areas and streams and connect these areas to the uplands by altering surface water pathways. This converts dispersed surface runoff and sediment filtering through a riparian area to direct deliveries of accumulated runoff and sediment. Decreases in riparian condition from increased in peak flows and sedimentation could occur, but would vary based on their current condition.

Pollutants and aquatic invasive species can be introduced directly or indirectly to aquatic systems from machinery or vehicles creating or using temporary roads. Pollutants in the form of fuels and lubricants have the potential to be introduced into aquatic systems from staging areas and equipment. Spills and leaks can introduce pollutants to soils and then to streams and riparian areas reducing riparian condition and habitat quality. Design features for storm water protections plans, staging areas, fuel storage and checking equipment for leaks minimizes the potential for introduction of pollutants. Aquatic invasive species can similarly be transferred from an infected water body to an uninfected waterbody through driving or placement of materials from an infected source. However, design features for decontamination of equipment and not transferring water are expected to minimize potential introduction or spread of invasive species.

Long term, potential direct and indirect negative impacts of temporary roads would cease as roads were decommissioned and revegetated. Therefore, long term effects are considered neutral to aquatic resource indicators. Overall, the potential short and mid-term negative impacts of temporary roads would be highest in Alternative 2 than Alternatives 1 and 3 based on mileage.

Sensitive Species not Covered by Resource Indicators and Measures

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles are strongly associated with streams and riparian areas. Based on the biology and ecology of the sensitive aquatic macroinvertebrate species, streams and riparian areas could have negative direct and indirect impacts from Alternatives 2 and 3 as described for federally listed species previously, but more impacts are expected for Alternative 2 based on the higher number of acres being treated. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats leading to impacts as described for fish and gartersnake species above. Alternatives 2 and 3 would have long-term benefits from reducing the risk of uncharacteristic wildfire and road densities as well as improved riparian and stream habitat from aquatic restoration.

Nokomis Fritillary is a sensitive species that utilizes meadows, seeps, and boggy streamside vegetation. As described above, both action alternatives could have negative direct and indirect negative impacts to the species and its habitat. Alternative 3 would have less direct and indirect negative impacts to the species and its habitat, than Alternative 2 for mechanical vegetation treatments, prescribed burning and roads. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats as described for fish and gartersnake species above. Ground disturbance and removal of vegetation would also reduce the availability of the butterflies host plant (*Viola nephrophylla*) short-term. Acres of riparian, grassland, and meadow treatments are the same between Alternatives 2 and 3, therefore potential direct and indirect impacts would be the same. Both alternatives would potentially having long-term benefits from reducing encroachment into its habitat, reducing the risk of uncharacteristic wildfire and lowering road densities.

The California Floater was once present in Fossil Creek, West Clear Creek, and Upper Clear Creek and it is possible that it may still occur within Chevelon Creek below Chevelon Dam. Direct and indirect negative impacts could occur in Upper Clear Creek and West Clear Creek, while no direct impacts would occur in Chevelon Creek and Fossil Creek. Direct impacts would include physical alteration of habitat and harm or harassment of individuals. Indirect impacts would include increases in erosion and sedimentation, as well as alteration of flows and habitats as described for fish and gartersnake species above. Mechanical vegetation treatments prescribed burning, and temporary roads would only have indirect impacts as they would not occur within streams. Opening ML1 roads and road relocation/decommissioning would have both direct and indirect impacts. . Both alternatives would potentially having long-term benefits from reducing the risk of uncharacteristic wildfire and reduced road densities; however Alternative 2 would provide more long-term benefit from higher number of acres treated.

For all sensitive aquatic macroinvertebrates, streams and riparian areas could have negative direct and indirect impacts from Alternative 3, but less than Alternative 2 given the decrease in acres treated. Direct and indirect negative impacts for road use, relocation and decommissioning would be the same for both Alternative 2 and 3. Direct and indirect impacts from temporary roads would be less in Alternative 3 than Alternative 2 given the reduction in proposed miles. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats that negatively impact these sensitive species as described for fish and gartersnake species above. Alternative 3 would potentially having long-term benefits from reducing the risk of uncharacteristic wildfire and reduced road densities.

Cumulative Effects

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

The cumulative effects analysis geographic boundary is the Rim Country project area. The following list summarizes the past, present, and future activities that add to the cumulative effects.

Cumulative effects to aquatic species and habitats are those effects from past, other present, and reasonably foreseeable future projects that result in changes to vegetative cover, soil and stream flow conditions, and contaminants that affect riparian condition and habitat. Activities that could have a cumulative effect include recreation such as dispersed camping and illegal road and trail creation, OHV use, forest restoration projects, fuels reduction projects, wildfire, roads and trails, road closures, and climate change. Most activities would be expected to result in localized impacts short to mid-term.

All recent and planned forest restoration, fuels reduction, and road decommissioning were and would be designed with similar protection measures, design features, and best management practices that are expected to further reduce cumulative impacts to aquatic habitats and species such as, spreading treatments out in space and time within watersheds are part of both action alternatives. Conversely, improvement in habitats would be expected in those areas where off-road travel is limited, road densities are reduced and habitat connectivity increased under implementation of travel management regulations and restoration activities that improve forest resiliency and riparian condition and stream habitat. Aquatic restoration activities have been individual small efforts with localized and short-lived impacts of increased sedimentation and long term habitat improvement where they have occurred.

Cumulative Effects for Alternative 1

Under alternative 1, there would be no affect during implementation to species, riparian condition or habitat. However the ability to retain sustainable and resilient ecosystems would be further compromised by the impacts of climate change, vulnerability to high-severity fires and associated post-fire flooding. Conifer encroachment would continue into riparian areas reducing streamside vegetation cover and structure normally associated with streams and wetlands negatively impacting riparian condition and habitat. Alternative 1 does not provide for improved riparian condition, aquatic species, or habitat. Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put aquatic species and their habitats at risk.

Cumulative Effects common to Alternatives 2 and 3

Timber Harvest and Vegetation Management

Past timber harvest activities have resulted in substantial negative impacts to watersheds, hydrologic conditions, riparian and aquatic habitat, and fish species across the proposed project area. This activity has resulted in most of the existing maintenance level 1 and 2 roads. More recent vegetation treatments such as Upper Beaver Creek, Rim Lakes, Larson, and CC Cragin likely have had less impacts due to spreading treatments across watersheds in time and space to reduce overall watershed and soils impacts. Fuelwood collecting and harvesting is also a very widespread activity occurring across the project area, but is generally dispersed across the landscape which limits any potential increased sedimentation or ground disturbance.

Cumulative effects of past timber harvest would combine with short to mid-term increases in sediment delivery and peak flows. These are expected to vary based on current riparian condition. Cumulative impacts for species such as gartersnakes, desert sucker, and Sonoran sucker with overall poor riparian condition are expected to be higher as compared to riparian conditions that are in good or fair condition (Table 82). Vegetation in poor riparian condition is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. Therefore, they have less ability to process additional sediment or stream flows. As described previously, riparian condition for all the other species is in good to fair riparian condition so they are able to process pulses of sediment and stream flow. To reduce the potential for cumulative impacts of sedimentation and peak flows, design features such as, spreading treatments out in space and time within watersheds are part of all recent and planned forest restoration projects such as CC Cragin, Rim Lakes, and East Clear Creek.

Recreation and Recreation Management

Recreational activities occur throughout the proposed project area, and are continuing to increase. Developed recreation sites, dispersed camping, hiking, fishing, hunting, OHV use, boating, wildlife viewing, and many other types of recreational activities occur across proposed project area. Riparian areas, lakes, and streams are very popular areas for recreational activities and dispersed camping; this can result in localized deteriorated resource conditions from the concentrated use (for example, loss of vegetation and soil compaction), and can also impact water quality from sedimentation. Recreational activities can also facilitate the spread of diseases, aquatic invasive species, and nonnative aquatic species which compete with and predate upon native federally listed and sensitive species.

Recreational activities would be expected to combine with Rim Country in localized impacts short to mid-term decreases in riparian condition, increased sedimentation, and increases in disease and aquatic invasive species. Implementation of travel management should decrease OHV impacts while state and federal educational programs continue to inform the public of how to reduce potential spread of aquatic diseases or invasive species. Rim Country would not have a cumulative effects on presence or spread of nonnative aquatic species.

Fire Suppression and Fire Management Projects
Fire suppression activities have been in place for decades, and have resulted in unnatural vegetative conditions and have altered ecological processes across most of the proposed project area. Suppression activities are ongoing and would continue well into the future, as vegetation structure and composition has been altered so that allowing it to burn would result in uncharacteristic and unacceptable resource impacts. Fire suppression activities can also impact water resources and species dependent upon them by removing water, which usually occurs during the driest part of the year. Prescribed fire and burns have been occurring for the last 10-20 years, and have increased considerably in their extent and impacts over the last 5 to 10 years. Large, uncharacteristic wildfires have occurred across the proposed project area in the last 20 to 25 years, such as Rodeo-Chediski Fire (2002).

Past fire management has resulted in the current condition in many watersheds from years of fire suppression leading to the uncharacteristic fires occurring recently. Wildfires can have both impacts that are both positive and negative as described previously and depend upon burn severities. Cumulatively these impacts would be dependent on the existing resource conditions and the future environmental conditions. Climate change is expected to result in increased temperature, frequency and intensity of drought, and wildfire risk; which could result in increased sedimentation and reduced riparian condition across large portions of the project area. The proposed action would limit this effect by making forest conditions more resilient to large-scale wildfire.

Livestock Grazing
Grazing livestock has likely occurred for over a century across the proposed project area. Historically unrestricted and unregulated resulted in overgrazing, especially within riparian areas, has likely contributed to the degraded riparian and aquatic habitat conditions that currently occur. Livestock grazing occurs over most of the proposed project area, although some areas are excluded for resource recovery reasons. Infrastructure development and maintenance associated with livestock grazing allotments is substantial and can include brushing or removal of vegetation as well as stock tank cleaning. Instream stock tanks occur throughout the proposed project area which decrease stream flow and alter stream habitat. Impacts to aquatic habitat and species, hydrologic conditions and processes, and riparian and upland conditions have occurred; and this would continue as long as livestock management and the associated infrastructure remains in place, and contributes cumulative effects to aquatic species and their habitats.

Cumulative effects of livestock grazing would combine with short-term impacts to riparian condition through loss of understory vegetation and increased sedimentation. Allotments in and around the project area should be managed on a grazing system designed to allow forage a chance to recovery from livestock grazing reducing the potential for cumulative impacts. Pastures may be rested or deferred after completion of ground disturbing activities (for example, thinning or burning) to minimize impacts to vegetation. This when combined with the effects of other past, present, and foreseeable future activities in area is not expected to result in a net cumulative effect of disturbance to aquatic species or habitats.

Road and Trail Construction, Maintenance, and Closure

As previously stated past timber activities and harvest primarily accounted for road development and placement, and this is still reflected in the existing transportation system. Approximately 5,682 miles of roads and almost many miles of hiking trails occur within Rim Country. User created roads and trails also occur on the landscape and further increase the overall mileage. While roads and trails are necessary for the use, enjoyment, and management, they also are responsible for considerable landscape scale changes to the functioning and maintaining of ecological processes and values. Maintenance activities for roads and trails are limited by available funding, and can result in both positive and negative benefits, depending on when it occurs and how often. These impacts would continue as long as the roads/trails are in place, and are a major contributor to cumulative effects. The Coconino National Forest has closed over 90 miles of roads as part of focused watershed restoration activities in the Little Colorado River watershed. Continued use and maintenance of roads and trails can increase sedimentation to streams and cause fish passage barriers.

Cumulative effects of roads and trails would combine with short to long-term increases in sediment delivery and peak flows from Rim Country. These are expected to vary based on current riparian condition as previously described under timber harvest. Conversely, improvement in habitats would be expected in those areas where road densities are reduced and habitat connectivity increased under implementation of travel management regulations and restoration activities that improve forest resiliency and riparian condition and stream habitat. All temporary roads for the project would be decommissioned, further reducing cumulative effects long-term.

Special Uses and Permits/Minerals Management/Land Exchanges

Hundreds of special uses permits have been issued across the proposed project area. These include permits for outfitter and guiding activities, fuelwood and Christmas tree cutting, road easements, plant and minerals collection, church and youth camps, gravel and cinder pits, ditch bill easements, communications sites, and other uses as well. All of these activities have contributed to current conditions, particularly ditch bill easements which can reduce the available water for aquatic habitat.

Cumulative effects of special uses, minerals, and land exchanges would combine with short term, localized increases in sedimentation and spread of aquatic invasive species or disease. The action alternatives limit these effects by keeping rock pits far away from aquatic habitats and reclaiming these areas when no longer needed. Design features associated with the action alternatives are expected to minimize or remove the potential for introduction or spread of aquatic invasive species or disease.

Dam and Reservoir Development/Water Diversions

These projects have resulted in considerable impacts to aquatic habitat and species both directly and indirectly. Dam and reservoir development began in the late 1800’s and continued into the 1960’s across the project area, altering stream habitat into lake habitat. Most of this activity was to provide for downstream (and off Forests) water use and irrigation as well as to provide for recreational opportunities. Blue Ridge Reservoir is part of an interbasin transfer to the Verde River from the Little Colorado River drainage to provide water downstream. Most dams and water diversions have detrimental impacts to aquatic species and habitats such as isolated or separated populations, loss of available habitat, and dewatered streams.

Cumulatively, these actions are part of the existing stream conditions. The action alternatives would improve remaining stream habitat and associated riparian areas. While there would be short-term increases in sedimentation from stream or riparian restoration; riparian and stream conditions would be improved long-term.

Fisheries and Wildlife
Fisheries habitat improvement work in streams began in the 1930s on the Apache-Sitgreaves National Forests. These efforts were in response to degraded habitat conditions (likely from grazing livestock) and were focused on higher elevation trout streams, and intended to stabilize streams and provide pool habitat that had been reduced. Later efforts did not occur until the1970s thru the 1980s, and these efforts were largely focused on areas that had been heavily impacted by past management activities and concentrated recreational use. The Coconino National Forest began improving streams, springs and watersheds in the 1960s thru the 1990's in response to the degraded conditions. This included instream rock structures and aspen and riparian enclosures. Spring and stream restoration efforts began in the early 2000's as part of watershed planning for West and East Clear Creek as well as Barbershop Canyon.

Cumulatively, aquatic restoration activities have been individual, small efforts with localized, short-lived impacts of increased sedimentation and long term habitat improvement where they have occurred. The action alternatives would improve riparian condition and aquatic habitats across the landscape.

In summary long term cumulative effects are expected to be positive for riparian condition for alternatives 2 and 3. Alternative 2 has the greatest potential to improve overall riparian condition as well as watershed condition due to highest acreage being treated. Alternative 3 would maintain or improve conditions, but at a smaller scale due to less acreage restored. Risk associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions would be improved by implementing the proposed treatments under all action alternatives.

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles are strongly associated with streams and riparian areas. Based on the biology and ecology of these four groups of species, streams and riparian areas could have negative cumulative impacts from Alternative 3, but less than Alternative 2 given the reduced mechanical vegetation treatments, prescribed burning, and temporary roads. Mechanical vegetation treatments, prescribed burning, and roads can negatively impact riparian condition, aquatic habitat quality and quantity utilized by these sensitive species. However, alternative 1 has the greatest potential long term risk to habitat for aquatic macroinvertebrates. By not making forests more resilient, the landscape remains susceptible to wildfires which have an even greater overall impact. Alternative 1 would also not reduce road density by decommissioning roads or reduce impacts to riparian condition by relocating roads. Alternatives 2 and 3 have the potential to improve riparian conditions by restoring form and function of streams, wet meadows and springs which are the primary habitat of these sensitive species.

Aquatic Threatened, Endangered, and Sensitive Species and Habitat Determinations

Table 96. Preliminary Determinations for Threatened, Endangered, and Candidate Species within Rim Country Analysis Area for Both Action Alternatives. MA= May Affect; MII = May Impact Individuals

Species Status	Status	Species Determination	Critical Habitat Determination
Gila trout	Threatened	Alternative 2: MA Alternative 3: MA	N/A
Gila chub	Endangered with Critical habitat	Alternative 2: MA Alternative 3: MA	Alternative 2: MA Alternative 3: MA
Gila topminnow	Endangered	Alternative 2: MA	N/A

Species Status	Status	Species Determination	Critical Habitat Determination
		Alternative 3: MA	
Little Colorado Spinedace	Threatened with Critical Habitat	Alternative 2: MA Alternative 3: MA	Alternative 2: MA Alternative 3: MA
Razorback sucker	Endangered with Critical Habitat	Alternative 2: MA Alternative 3: MA	Alternative 2: MA Alternative 3: MA
Loach minnow	Endangered with Critical Habitat	Alternative 2: MA Alternative 3: MA	Alternative 2: MA Alternative 3: MA
Spikedace	Endangered with Critical Habitat	Alternative 2: MA Alternative 3: MA	Alternative 2: MA Alternative 3: MA
Narrow-headed gartersnake	Threatened with proposed Critical Habitat	Alternative 2: MA Alternative 3: MA	Alternative 2: MA Alternative 3: MA
Northern Mexican gartersnake	Threatened with proposed Critical Habitat	Alternative 2: MA Alternative 3: MA	Alternative 2: MA Alternative 3: MA
Desert sucker	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
Sonoran sucker	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
Little Colorado sucker	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
Headwater chub	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
Roundtail chub	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
Netwing Midge	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
A Stonefly	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
Parker’s cylloepus riffle beetle	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
A Mayfly	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
A Mayfly	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
A Caddisfly	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
A Caddisfly	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
A Caddisfly	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
Ferris’ Copper	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
Nokomis Fritillary (aka Great Basin Silverspot)	Sensitive	Alternative 2: MII Alternative 3: MII	N/A
California floater	Sensitive	Alternative 2: MII Alternative 3: MII	N/A

Rare Plants

Affected Environment

This section details the affected environment and environmental consequences for the threatened, endangered and Southwestern Region Regional Forester's sensitive plants (hereafter Southwestern Region sensitive plants), within the project area. It establishes the baseline against which the decision maker and the public can compare the effects of the action alternatives.

This section also describes the direct, indirect, and cumulative effects of implementing each alternative on threatened, endangered and Southwestern Region sensitive plants. It presents the scientific and analytical basis for the comparison of the alternatives presented in Alternatives section. The information presented here is part of the Botany and Noxious Weeds specialist report (Crisp 2018), which is incorporated by reference.

Assumptions

The environmental effects disclosed for rare plants are based on the following assumptions:

- All relevant laws, regulations, manual guidance and Forest Service policy relating to management of the resources discussed within are followed during analysis and implementation.
- Management would follow the guidance of the Forest Plans.
- Silviculture and prescribed burning treatments would be implemented as written and addressed in the Silviculture and Fire Ecology and Air Quality specialist reports and not substantially modified without review of the effects of such activities.
- Management activities related to roads and transportation as well as spring and channel restoration would be implemented as addressed in their respective reports and not substantially modified without review of the effects of such activities.
- Prescribed fires would be of lower severity and intensity in any given area compared to large-scale wildfires in the same area so the amount of disturbance from prescribed burning is less than compared to wildfires.
- Fire effects to individual species vary depending on several factors including life cycle, time of burning and several biotic and abiotic factors (Pyke et al 2010). As a result, the responses of the plant species discussed in this report may vary in any given area or time. The effects of fire on these species would be mitigated through the burning prescription.
- Areas to be treated would be surveyed for Southwestern Region sensitive plants before and after treatments are implemented. These factors should be considered when identifying survey needs
- Target special features and microhabitat needed by the species of interest. This is generally only a small portion of the area, and is estimated to be 5 percent or less of any given area.
- Survey and mitigation would be based on the likelihood of any of the species addressed in this document occurring within the project area. Not all areas contain suitable habitat for a given species.
- The amount of disturbance predicted to occur during treatment. For example, surveys may not be needed in areas scheduled for prescribed burning if the treatments are scheduled to be of low intensity.

- Areas to be treated would be surveyed for noxious or invasive weeds before and after treatments are implemented. These factors should be considered when identifying survey needs
- Likelihood of any of the species addressed in this document occurring within the project area
- Amount of disturbance. For example, surveys may not be needed in areas scheduled for prescribed burning if the treatments are scheduled to be of low intensity.
- Application of the design features, BMPs, and mitigation and conservation measures discussed in the Rare Plants section of chapter 3 and in appendix C are included in analysis and project implementation.
- The acreage of potential disturbance in this project is much larger than generally analyzed in similar projects, necessitating more noxious or invasive weed treatments to control invasive species. This would lead to increases in personnel and budget to accomplish this need.

Questions to Answer through Analysis

How would proposed treatments affect Southwestern Region sensitive plant species? The indicators used to evaluate environmental consequences are: (1) a qualitative evaluation of whether populations are maintained or increased per FSM 2760. 5(19), (2) a qualitative evaluation of whether potential habitat is maintained or enhanced, (3) an evaluation of whether impacts to sensitive plants and their habitats are effectively minimized, and, (4) an evaluation on habitat and species resiliency to natural disturbances including fire and climate change.

A unit of measure for Southwestern Region sensitive plant species is to maintain or increase the populations within the project area. Additionally, potential habitat for these species should be maintained or enhanced.

How would project activities affect interactions between noxious or invasive weeds and Southwestern Region sensitive plants?

Indicators/Topics of Analysis

The indicators used to evaluate environmental consequences are:

13. A qualitative evaluation of whether populations are maintained or increased per FSM 2670.5(19)
14. A qualitative evaluation of whether potential habitat is maintained or enhanced
15. An evaluation of whether effects on sensitive plants and their habitats are effectively minimized
16. An evaluation on habitat and species resiliency to natural disturbances including fire and climate change.

Federally Listed Threatened or Endangered Plants

The Rim Country project area **does not include** any locations or potential habitat for Threatened or Endangered plant species so no threatened or endangered plant species will be analyzed for this project

Southwestern Region Regional Forester's Sensitive Plants

Table 97 displays the Southwestern Region sensitive plants occurring within the project area.

Table 97. Southwestern Region Regional Forester's Sensitive Plants found in the Project Area

Common name	Scientific Name	Forest	ERU/Habitat	Data source	Notes
Villous groundcover milkvetch	*Astragalus humistratus var. crispulus*	Apache Sitgreaves	Narrow-leaf cottonwood/shrub. These occurrences are in the Rodeo-Chediski Fire (2002) and are in severely disturbed sites.	HDMS Data SEINet	N/A
Arizona Bugbane	*Actaea* (*Cimicifuga*) *arizonica*	Coconino, Tonto	Ponderosa pine, Mixed Conifer with Aspen	HDMS, SEINet and Forest Service files.	Arizona bugbane occurs mostly in deep canyons.
Dane Thistle	*Cirsium parryi ssp. mogollonicum*	Coconino	Springs	Goodwin (2005)	Field notes prepared by Goodwin (2005) provide the most accurate location and condition description for this species.
Hairy Clematis (Arizona leatherflower)	*Clematis hirsutissima var. hirsutissima*	Coconino	Ponderosa pine	FS files	Generally on limestone soils,
Mogollon Fleabane	*Erigeron anchana*	Tonto	Ponderosa pine/willow, ponderosa pine/evergreen oak, mixed conifer frequent fire.	SEINet, HDMS	Rock crevices or ledges on boulders and vertical rock faces, usually in canyons, usually on granite (HDMS 2003)
Rock Fleabane	*Erigeron saxatilis*	Coconino	Ponderosa pine, Mixed Conifer Frequent Fire, narrow-leaf cottonwood/shrub, willow/alder, Mixed Conifer with Aspen	SEINet, HDMS, NRM/TESP	Cliffs or vertical rock faces, usually on Coconino sandstone
Arizona Sneezeweed	*Helenium arizonicum*	Coconino, Apache - Sitgreaves	Ponderosa pine Forest (wet meadows) Apache Sitgreaves Ponderosa pine, Montane subalpine grasslands	SEINet, FS files and local knowledge, NRM/TESP	N/A

Common name	Scientific Name	Forest	ERU/Habitat	Data source	Notes
Eastwood (Senator Mine) Alumroot	*Heuchera eastwoodiae*	All	Ponderosa Pine Evergreen Oak,(TNF) Mixed Conifer Frequent Fire (TNF) Mixed Conifer with Aspen (TNF, A-S) Cottonwood Shrub (TNF), Ponderosa Pine/Willow (TNF, A-S) and Ponderosa Pine (A-S)	SEINet and HDMS	Specimens for this species on the Coconino NF have been reclassified to another species (Folk and Alexander 2015)
Flagstaff beardtongue	*Penstemon nudiflorus*	Coconino	Ponderosa pine/Gambel oak	HDMS, NRM/TESP	N/A
Blumer's Dock	*Rumex orthoneurus*	All	Fremont cottonwood/shrub, herbaceous, Mixed conifer frequent fire, mixed conifer with aspen, narrow leaf cottonwood/shrub, ponderosa pine/evergreen oak, ponderosa pine/willow and ponderosa pine forest.	SEINet and HDMS	N/A
Bebb’s Willow	*Salix bebbiana*	Coconino, Apache-Sitgreaves	Montane willow riparian forest.	SEINet	N/A

Environmental Consequences

Alternative 1 – No Action

Southwestern Region Regional Forester's Sensitive Plants

Direct and Indirect Effects common to all species

Alternative 1 is the no action alternative. This alternative would not address the purpose and need for the Rim Country Project and would provide any progress toward the improved conditions addressed in each of the three forest's Land Resource Management Plans (LMRPs).

Specifically portions of the purpose and need that would improve habitat for these species would not be addressed.

- There would be no increase in forest resiliency and sustainability
- The risk of uncharacteristic fire effects would not be reduced.
- Habitat for wildlife and aquatic species would not be improved
- Conditions and function of streams and springs would not improve
- There would be no opportunity to restore woody riparian species, including Bebb's willow.

There would be no tree cutting and no prescribed burning, so no reduction in , tree density and canopy would not be reduced Conditions associated with dense ponderosa pine stands result in physiologically stressful environments for understory plants. Stressors include increased shading, deep litter horizons, low soil moisture, low nutrient availability and contribute to a decline in species richness within the plant community. (Laughlin and others 2011). These factors affect all understory species including Region 3 sensitive plants. There would continue to be a reduction or loss of understory vegetation and therefore, a loss of understory services.

With no treatment, fire hazard would continue to increase therefore increasing the risk of severe wildfire in many parts of the project area (see Vegetation and Fire Reports for more information). Factors that contribute to fire hazard ratings that would be reduced through management actions such as canopy cover, trees per acre and dead and down fuel loading would not be reduced. The risk of wildfire transitioning to crown fires would increase in many areas of the project area resulting in the increased risk of severe wildfire and degradation of potential habitat. Severe wildfires often result in short and long-term effects, which include removal of tree canopy, loss of the understory plant community and alteration of soil structure and nutrients (Pyke and others 2010). These changes could adversely affect the habitat and populations of Region 3 sensitive plants by damaging soil, killing existing plants and by reducing or destroying the seed bank. Fire size may also increase, leading to largescale crown fires, which in turn may cause a permanent loss in understory diversity (Covington 2000). Primary fire effects such as loss of individual plants or groups may recover in a matter of a few years. However, secondary effects such as permanent changes in biotic and abiotic factors can result in permanent changes in the post fire plant community (see Pyke and others 2010).

There would be no opportunities to improve the condition and function of streams and springs so opportunities to improve habitat for such species as Arizona sneezeweed, Bebb's willow and Blumer's dock would not occur and areas that might have historically provided habitat for these species and would remain degraded and unsuitable for these and other plant species that require mesic conditions for their survival.

With no action, there would be no restoration of structure and function in the treatment areas, resulting in continued departure from the desired conditions for all resources in this project, including Region 3 sensitive plant species.

If Alternative 1 is selected management actions such as fuels reduction projects, prescribed fire, spring and channel restoration would be limited to those analyzed and implemented by the individual projects analyzed in other NEPA on each forest.

Determination of Effects

Alternative 1 of the Rim Country EIS would not impact individuals of any of the Region 3 sensitive plant species discussed in this analysis and is not likely to result in a trend toward federal listing or loss of viability. This is because no management actions would occur as a result of this project.

Effects Common to Alternatives 2 and 3

Villous groundcover milkvetch (Astragalus humistratus var. crispulus)

Villous groundcover milkvetch is a Region 3 sensitive species for Apache Sitgreaves. Its distribution is limited to southeastern Apache County in Arizona and in neighboring Catron County in New Mexico where it grows on sandy soils of volcanic origin in dry pine forests (Spellenberg 2007). The occurrences on the forest are in narrow-leaf cottonwood/shrub ERUs.

Direct and Indirect Effects

The known occurrences of villous ground cover milkvetch are in areas proposed for stream channel restoration on the Apache-Sitgreaves National Forests. The project activities would help move the treated areas toward the desired conditions as described in the Apache-Sitgreaves LRMP including mitigating the landscape scale disturbance that occurred as a result of the Rodeo-Chediski Fire in 2002.

The plant locations were documented in 2014 so are present despite the disturbance from the fire. No scientific data or publications were found that document the effects of fire on the plant. Villous groundcover milkvetch has been observed growing in roadbeds so is assumed to tolerate disturbance (Spellenberg 2007) so would likely tolerate the burning treatments proposed for these areas.

Management activities related to stream restoration could result in the damage or loss of individual plants or groups of plants at the two known locations. This can be mitigated by following the guidelines for wildlife and rare plants in the forest plans, stating that modifications, mitigations, or other measures should be incorporated to reduce negative impacts to plants, animals, and their habitats and to help provide for species needs, consistent with project or activity objectives.

The management activities needed to restore the stream channels would be guided by the Aquatic Toolbox which would also mitigate the loss of plants. It is anticipated that the tools for improving the form and function of stream channels and floodplains (see appendix D) and the tools for improving spring outflows would be used at these sites.

Cumulative effects

The timeframe for analysis of cumulative effects on villous groundcover milkvetch is from 2002 when the Rodeo-Chediski Fire burned through the area to 20 years in the future. The area of this analysis is the project boundary. The degraded channels in the area may be attributed at least in part to the effects of the Rodeo-Chediski Fire in the areas around the occurrences of villous groundcover milkvetch as well as in the watersheds above and attributed to the need for action to restore these channels.

The effects of recreation on the plants at Black Canyon Lake when added to the effects of implementing the activities proposed in the Rim country Project may attribute to the impacts to the villous groundcover milkvetch in the area.

Other documented occurrences of villous groundcover milkvetch are within the Heber Wild Horse Territory. Desired conditions for this area include grazing that is in balance with the available forage. It is not known if horses or other grazers in the area utilize villous groundcover milkvetch as forage so cumulative effects are also unknown.

Determination of Effect

Implementation of Alternative 2 or 3 of the Rim Country EIS may impact individuals of villous groundcover milkvetch (*Astragalus humistratus* var. *crispulus)* but is not likely to result in a trend toward federal listing or loss of viability.

Dane (Mogollon) thistle (Cirsium parryi subsp. mogollicum)

Dane thistle is a Region 3 sensitive species for Coconino National Forest. It is endemic to a few canyons on the Mogollon Rim Ranger District.

Direct and Indirect Effects

The known range of Dane thistle is a small portion of the overall project area. At least one occurrence of Dane thistle was protected with a small wire structure in the past but this area has not been revisited in several years so the fates of the plants and structure are unknown. Two occurrences of Dane thistle are within the Coyote Springs Mexican Spotted Owl (MSO) PAC and would be treated using the PAC Mechanical, a treatment designed to reduce the risk of uncharacteristic wildfire in MSO PACs. Trees removed from areas in this treatment are generally smaller in diameter than those removed in other treatments. Canopy cover after treatment is generally higher as compared to those prescribed for areas outside MSO habitat. The third occurrence in outside the Coyote Springs PAC in recovery habitat. The most significant effect to Dane thistle from this treatment is direct losses of individuals from management actions and these can be mitigated by using design features and mitigations.

Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss of shade, increased risk of noxious or invasive weeds and an increased risk of erosion. This would be mitigated by burning at intensities in all entries low enough to limit mortality to trees.

The management activities would help move the treated areas toward the desired conditions. The effects of disturbance from vegetation treatments and prescribed fire include loss of individual plants.

Aquatic restoration includes site disturbing activities that would affect the occurrences of Dane thistle, especially the northernmost occurrence which is less than 1/10th mile from a proposed restoration site. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

There are no rock pits or in-woods processing areas near Dane thistle so effects from management activities associated with rock pits or in-woods processing sites would occur.

The locations of Dane thistle are not near any roads so there are no effects from management actions along roads.

Cumulative effects

The area of this cumulative effects analysis includes the known range of Dane thistle. The timeframe begins when Dane thistle was first described in 1990 to twenty years in the future.

There have been a variety of management activities in the uplands surrounding the known Dane thistle occurrences but few activities have occurred in the steep canyon areas. Grazing by cattle has occurred in the past but the allotment containing Dane thistle is not currently being used. Grazing by wildlife still occurs. A limited amount of recreational activities such as hiking may occur in the areas but there are no established trails in the canyon areas.

There is a large dispersed camping area in the uplands above one occurrence. A fence restricts vehicle travel and camping near the canyon edge. Hikers from the camping area may occasionally venture into the area. At the same site, there is an historical cabin and spring diversion upslope. Through another project there are plans to rehabilitate the spring, allowing it to be free-flowing but management actions from this action are not anticipated to have any effect on Dane thistle.

In addition to the management actions in this analysis, grazing by wildlife and recreation would continue in this area.

Cumulatively, the loss of individual plants may occur when added to the loss of plants as a result of grazing, creation and other prescribed fire or mechanical treatments implemented within the cumulative effects boundary.

Determination of Effect

Implementation of Alternative 2 or 3 of the Rim Country EIS may impact individuals of Dane thistle (*Cirsium parryi* ssp *mogollonicum*) but is not likely to result in a trend toward federal listing or loss of viability.

Mogollon fleabane (*Erigeron anchana*)

Mogollon fleabane is a Region 3 sensitive species for Tonto National Forest where it grows in cliff faces and rocky area.

Direct and Indirect Effects

Treatments in the area of known occurrences of Mogollon fleabane include mechanical and prescribed fire treatments (goshawk foraging; meadow restoration). The area is also near a stream channel proposed for aquatic restoration.

The vegetation and prescribed fire treatments would support the management emphasis for Mogollon fleabane, and he vegetation treatments would reduce the risk of uncharacteristic disturbances and would improve watershed condition. Prescribed fire would reduce the risk of uncharacteristic fire in the area surrounding this occurrence Mogollon fleabane and move toward allowing fire to resume its natural ecological role.

Aquatic restoration may include site disturbing activities that would affect this occurrence of Mogollon fleabane. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

The known occurrence of Mogollon fleabane is near the Bear Flat Campground near roadway so the species may be affected if construction, maintenance or reconstruction of the road occur, especially if the rocky areas favored by the species is affected. This can be mitigated by locating and avoiding the plants before activities occur.

There are no rock pits or in-woods processing areas near this occurrence of Mogollon fleabane so no effects would occur.

Cumulative effects

The timeframe of this discussion of cumulative effects on Mogollon fleabane is from 1990 to 20 years in the future. The area of this analysis is the project boundary. Many known locations of Mogollon fleabane are in wilderness or remote areas and would not be affected by management activities such as those proposed in this project.

Related to the known occurrence in the project area near the Bear Flat Campground, past and future impacts from recreational activities have occurred and would continue to occur near the site. Recreational activities such as rock climbing could also affect plants by crushing individuals and altering habitat.

Factors contributing to the degradation of Tonto Creek which flows through Bear Flat Campground could have impacted Mogollon fleabane so it is included in this analysis. Cumulatively aquatic habitat restoration activities, could conserve or improve the habitat of Mogollon fleabane in this area.

The past actions such as construction and maintenance of roads in the area could have contributed to the effects on habitat in this area, especially if rock formations were altered during construction and maintenance.

In addition to the management activities in this project, the foreseeable actions in area include recreation and occupancy of nearby land. Grazing by cattle and wildlife may occur in the area. Wildfire may also occur in the area. These may affect the habitat or plants occurring at this location but are not likely to affect the entire species.

Determination of Effect

Implementation of Alternative 2 or 3 of the Rim Country EIS may impact individuals of Mogollon fleabane (*Erigeron anchana*) but is not likely to result in a trend toward federal listing or loss of viability.

Rock (cliff) fleabane (*Erigeron saxatilis*)

Rock fleabane is a Region 3 sensitive species for Coconino National Forest. All known occurrences are limited to the Coconino National Forest.

Rock fleabane is a small daisy-like plant that tends to grow in erosion pockets on vertical cliff faces, most commonly Coconino sandstone. Generally, risks from management activities are confined to activities that would affect the cliff habitat on which it depends.

Direct and indirect effects

Two areas containing rock fleabane are slated for mechanical treatment (goshawk foraging). The effects of mechanical treatment include loss of individual plants or groups of plants. These effects would be mitigated by using the design features in appendix C.

Prescribed fire would occur throughout the project area but rock fleabane tends to occur in rocky areas that are sheltered from most fire activities so effects to the species from burning are anticipated to be minimal. Management activities such as fireline construction are not likely to occur in these areas. Short-term effects of prescribed fire include loss of individual plants. There are two occurrences of rock fleabane in aquatic restoration areas. The risk to rock fleabane from management actions include loss or damage of plants or loss of habitat. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

An indirect effect of management actions within the potential habitat of rock fleabane includes an increased risk of invasion from noxious or invasive weeds incorporation of the design features, in appendix C would mitigate the effects of increased disturbance from management activities, and help to control the spread and introduction of weeds within the habitat of rock fleabane.

Two occurrences of rock fleabane appears to be near roadways so may be affected if construction, maintenance or reconstruction of the road occurs, especially if the rocky areas favored by the species is affected.

Factors contributing to the degradation of aquatic habitats that led to the decision to include the areas in this analysis may have also affected the habitat of rock fleabane. Aquatic habitat restoration, depending on the actions taken could preserve or improve the habitat of rock fleabane in this area, depending on the actions taken by restoring the general area and reducing effects such as erosion in the long term.

There are no rock pits or in-woods processing areas near this occurrence of rock fleabane so no effects would occur.

These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Cumulative effects

The timeframe considered is from 1990 to 20 years in the future. The area of this analysis is the project boundary.

Factors contributing to the degradation of areas scheduled for aquatic restoration that led to the decision to include it in this analysis may have also affected the habitat of rock fleabane. Aquatic habitat restoration, depending on the actions taken could preserve or improve the habitat of rock fleabane in this area.

The past actions such as construction and maintenance of roads in the area could have contributed to the effects on habitat in this area, especially if rock formations were altered during construction and maintenance.

In addition to the management actions in this analysis, grazing by cattle and wildlife may occur in the area. Wildfire may also occur in the area. These may affect the habitat or plants occurring at this location but are not likely to affect the entire species.

Determination of Effect

Implementation of Alternative 2 or 3 of the Rim Country EIS may impact individuals of rock fleabane (*Erigeron saxatilis*) but is not likely to result in a trend toward federal listing or loss of viability.

Eastwood (Senator Mine) Alumroot (Heuchera eastwoodiae)

Eastwood Alumroot is a Region 3 sensitive species for all three forests. Eastwood alumroot is endemic to central Arizona where it grows on moist shaded slopes in ponderosa pine forests and canyons. The typical substrate is crevices in basalt soil or basalt soil (Arizona Game and Fish Department 2005).

Direct and indirect effects

There is one occurrence of Eastwood alumroot in an area slated for mechanical treatment. The effects of mechanical treatment include loss of individual plants or groups of plants.

Prescribed fire would occur in the project area. Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include, increased risk of noxious or invasive weeds and an increased risk of erosion.

Hunter and Christopher Creeks are slated for riparian restoration. The risk to Eastwood alumroot from these actions include loss or damage of plants or loss of habitat. . Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features mitigate loss of sensitive plants by avoiding them as much as possible.

An indirect effect of management actions within the potential habitat of Eastwood alumroot includes an increased risk of invasion from noxious or invasive weeds Incorporation of the design Features, best management practices, mitigation and conservation measures in appendix C would mitigate these effects.

There are no rock pits or in-woods processing areas near this occurrence of Eastwood alumroot so no effects would occur.

Cumulative effects

The area of consideration for this discussion is the project area boundary. The timeframe includes 20 years past and future. Although this species occurs on all three forests within the project area, no data were found to document the effects of management on the species. Several of the areas where Eastwood alumroot occurs are in remote areas and/or in wilderness areas such as the Sierra Ancha, Red Rock Secret Mountain, and Mazatzal Mountains where no management activities would occur. Past impacts to basalt soils and crevices, especially in canyons and drainage areas may have affected individuals, groups or habitat for Eastwood alumroot. Dispersed recreation, especially activities such as canyoneering and rock climbing occur in potential habitat for Eastwood alumroot.

Determination of Effect

Implementation of Alternative 2 or 3 of the Rim Country EIS may impact individuals of Eastwood (Senator Mine) alumroot (*Heuchera eastwoodiae*) but is not likely to result in a trend toward federal listing or loss of viability.

Blumer's Dock (*Rumex orthoneurus*)

Blumer’s dock is a Region 3 sensitive species for all three forests. Blumer’s dock is a large, long-lived herbaceous perennial plant endemic to New Mexico and Arizona. Its range is from east-central to southeastern Arizona (depending on taxonomic interpretation). Habitat for Blumer’s dock includes mid- to high-elevation wetlands with moist, organic soil adjacent to perennial springs or streams in canyons or meadows (Arizona Game and Fish Department 2002.

Direct and indirect effects

Most of the occurrences of Blumer’s dock occur in areas scheduled for riparian restoration, with some in areas where wet meadow restoration is planned.

The risk to Blumer’s dock from management actions to restore aquatic habitats and stream channels include loss or damage of plants or loss of habitat.

Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their

These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

An indirect effect of management actions within the potential habitat of Blumer's dock includes an increased risk of invasion from noxious or invasive weeds.

Prescribed fire would occur in the project area. Short-term effects of prescribed fire include loss of individual plants but these can be mitigated by using design features.

There are no rock pits or in-woods processing areas near the occurrences of Blumer's dock so no effects would occur.

Blumer's dock may occur near roadways so may be affected if construction, maintenance or reconstruction of the road occurs and can be mitigated by locating and avoiding the plants before activities occur.

Cumulative effects

The area of consideration for this discussion includes the portion of the project area containing Blumer's dock plants and habitat, especially the drainages in the area. The timeframe is from 1993 to 20 years in the future. The 1993 timeframe was chosen to allow inclusion of introductions of Blumer's dock on the Apache-Sitgreaves and Tonto National Forests as documented in the Conservation Strategy. These introductions were implemented to supplement the numbers of plants and populations of this rare species. The fates of many of these introductions are unknown but are not thought to have persisted. This would affect the distribution of Blumer's dock in the project area and could affect the mitigations and management actions for restoring these areas. A series of exclosures on Apache-Sitgreaves National Forests protects some of these sites.

Several large fires have occurred in the project area. The largest of these is the Rodeo-Chediski (2002). It and other large fires have affected the terrestrial and aquatic habitats in the area containing Blumer's dock by destroying or altering vegetation communities, creating landscape scale disturbance, contributing to the risk of invasion of noxious or invasive weeds and contribution to erosion.

Grazing by livestock and wildlife has occurred and would continue to occur in the area. Blumer's dock is palatable to animals and small populations may be completely eaten in a single year. Activities such as dispersed recreation and firewood gathering have occurred and would continue to occur in the area.

Determination of effect

Implementation of Alternative 2 or 3 of the Rim Country EIS may impact individuals of Blumer's dock (*Rumex orthoneurus*) but is not likely to result in a trend toward federal listing or loss of viability.

Bebb's Willow (*Salix bebbiana*)

Bebb's willow is a Region 3 sensitive species for Coconino and Apache-Sitgreaves National Forests. It occurs in several areas containing riparian habitat within the project area.

Direct and indirect effects

Some of the areas containing Bebb's willow would receive vegetation treatments. The effects of mechanical treatment include loss of individual plants or groups of plants. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible. .The risk to Bebb's willow from management actions to restore aquatic habitats and stream channels include loss or damage of plants or loss of habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features and mitigations to minimize the loss sensitive plants by avoiding them as much as possible. .

Prescribed fire would occur in the project area. The effects of prescribed fire include loss of individual plants. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

An indirect effect of management actions within the potential habitat of Bebb's willow includes an increased risk of invasion from noxious or invasive weeds Incorporation of the design Features, best management practices, mitigation and conservation measures in appendix C.

There are no rock pits or in-woods processing areas near the occurrences of Bebb's willow so no effects would occur.

Bebb's willow may occur near roadways so may be affected if construction, maintenance or reconstruction of the road occurs and can be mitigated by locating and avoiding the plants before activities occur.

Cumulative effects

The area of consideration for this discussion includes the portion of the project area containing Bebb's willow and its habitat, especially the drainages in the area. The timeframe is 20 years past and in the future.

There are a series of exclosures on the Apache-Sitgreaves National Forests and Coconino National Forests. Some of contain, or were designed to protect, Bebb's willows. The status of these is unknown.

Several large fires have occurred in the project area. The tops of Bebb's willow may be removed by fire but the species is able to regenerate through basal sprouting. However, regeneration is often targeted and eaten by domestic and wild grazers, leading to depletion of underground reserves ultimately leading to the loss of plants in areas of heavy grazing pressure.

Grazing by livestock and wildlife has occurred and would continue to occur in the area. Bebb's willow is palatable to animals and small populations may be completely eaten in a single year. Activities such as dispersed recreation and firewood gathering have occurred and would continue to occur in the area.

Determination of Effect

Implementation of Alternative 2 or 3 of the Rim Country EIS may impact individuals of Bebb's willow (*Salix bebbiana)* but is not likely to result in a trend toward federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Arizona Bugbane (Cimicifuga arizonica)

Arizona bugbane is a Region 3 sensitive species for Kaibab, Coconino and Tonto National Forests. In this analysis occurrences of Arizona bugbane are limited to the Coconino National Forest. There are no known occurrences of Arizona bugbane within the Project area for Tonto National Forest. Arizona bugbane is endemic to northern Arizona where it occurs in mesic habitats, typically along the bottoms and lower slopes of steep, narrow canyons. The overstory often includes a combination of coniferous and deciduous tree species. The habitat is similar to that favored by Mexican spotted owls.

Direct and Indirect Effects

The proposed management actions would help move the treated areas toward the desired conditions as described in the LRMP. The most significant effect to Arizona bugbane from management actions is direct losses of individuals from management actions but these would be mitigated through the design features in appendix C.

This occurrence of Arizona bugbane is within the Tom's Creek Mexican Spotted Owl (MSO) PAC and would be treated using the PAC Mechanical, a treatment designed to reduce the risk of uncharacteristic wildfire in MSO PACs.

Trees removed from areas in this treatment are generally smaller in diameter than those removed in other treatments. Canopy cover after treatment is generally higher as compared to those prescribed using the mechanical toolbox for areas outside MSO habitat. Shade for Arizona bugbane plants in this area may be affected but it would not be extensive. This could result in the loss of a few individuals but would not affect the entire population at this site.

Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss of shade, increased risk of noxious or invasive weeds and an increased risk of erosion. This would be mitigated by burning at intensities in all entries low enough to limit mortality to trees. The current knowledge of fire effects on Arizona bugbane are based largely on observations on a local wildfire, the Fry Fire in 2003.

No hauling is proposed in the immediate area of Arizona bugbane populations. Indirect effects from road use would be limited to dust from road maintenance but these would be minimal and inconsequential.

An indirect effect of management actions within the potential habitat of Arizona bugbane includes an increased risk of invasion from noxious or invasive weeds. Incorporation of the design features would mitigate the effects of increased disturbance from management activities, and help to control the spread and introduction of weeds within the habitat of Arizona bugbane.

No locations of Arizona bugbane occur within sites for spring or channel restoration, so there are no effects to the species.

There are no rock pits or in-woods processing areas near this occurrence of Arizona bugbane so no effects would occur.

Cumulative effects

The following past actions have affected the abundance of Arizona bugbane and have established baseline current condition for Arizona bugbane; grazing, recreation, wildfire and natural disturbances such as flooding, drought, tornados and mortality in overstory trees. Grazing impacts were addressed in the Conservation Assessment and Strategy for the Coconino and Kaibab National Forests and include fencing and monitoring in certain populations which led to a reduction in these conflicts.

In addition to the management actions in this analysis, the foreseeable activities in area include recreation such as hiking, rock climbing and canyoneering. Grazing by cattle and wildlife would continue. Wildfires may also occur in the area. Singly, none of these activities would eliminate Arizona bugbane at the site.

Cumulatively, the effects from activities from this project when added to effects from other projects would also not eliminate bugbane at this site.

Determination of Effect

Implementation of Alternative 2 of the Rim Country EIS may impact individuals of Arizona bugbane (*Cimicifuga arizonica*) but is not likely to result in a trend toward federal listing or loss of viability.

Hairy Clematis (Arizona leatherflower) (Clematis hirsutissima var. hirsutissima) (syn. var. Arizonica)

Hairy clematis is a Region 3 sensitive species for Coconino National Forest where it occurs in ponderosa pine forests. There is one location of hairy clematis in a unit proposed for stream channel restoration.

Direct and Indirect Effects

The area containing hairy clematis is slated for mechanical treatment (goshawk foraging). The effects of mechanical treatment include loss of individual plants or groups of plants. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss of shade, increased risk of noxious or invasive weeds and an increased risk of erosion. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Activities associated with roads and transportation in this project would be limited those needed to accomplish the management actions that would occur in the area Effects to plants can be mitigated by locating and avoiding them.

An indirect effect of management actions within the potential habitat of hairy clematis includes an increased risk of invasion from noxious or invasive weeds

There are no rock pits or in-woods processing areas near this occurrence of hairy clematis so effects from management activities associated with rock pits or in-woods processing sites would occur.

Cumulative effects

The area of this analysis is the project boundary. The time frame is from 2005 to 10 years in the future which is considered the length of the decision to be made by this analysis.

One occurrence was detected in 2005 during a survey for the Bald Mesa Fuels Reduction Project. Since then there has been at least one entry of prescribed fire in this area. The effects were mitigated by locating and constructing hand line around the plants. Other activities include grazing and dispersed recreation in the uplands.

In addition to the management actions in this analysis, the foreseeable actions within the habitat of hairy clematis include recreation such as hiking and dispersed camping. Wildfires may burn in the area. Grazing by cattle and wildlife would continue. Singly none of these actions would eliminate the hairy clematis at the site

Determination of Effect

Implementation of Alternative 2 of the Rim Country EIS may impact individuals of Arizona bugbane (*Cimicifuga arizonica*) but is not likely to result in a trend toward federal listing or loss of viability.

Arizona sneezeweed (Helenium arizonica)

Direct and indirect effects

Arizona sneezeweed occurs on all three forests included in this analysis and within several treatments.

Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss or damage of plants, increased risk of noxious or invasive weeds and an increased risk of erosion.

An indirect effect of management actions within the potential habitat of Arizona sneezeweed includes an increased risk of invasion from noxious or invasive weeds Incorporation of the design features, best management practices, mitigation and conservation measures in appendix C would mitigate the effects of increased disturbance from management activities, and help to control the spread and introduction of weeds within the habitat of rock fleabane.

Arizona sneezeweed is known to occur in the following aquatic restoration units; Woods Canyon Creek, Chevelon Lake and Canyon Creek but may be in additional sites as well. Aquatic restoration may include site disturbing activities that would affect Arizona sneezeweed. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Arizona sneezeweed near roadways may be affected if construction, maintenance or reconstruction of the road occurs, especially if the rocky areas favored by the species is affected. This can be mitigated by locating and avoiding the plants before activities occur.

There are no rock pits or in-woods processing areas near this occurrence of Arizona sneezeweed so effects from management activities associated with rock pits or in-woods processing sites would occur.

Arizona sneezeweed may occur near roadways so may be affected if construction, maintenance or reconstruction of the road occurs and can be mitigated by locating and avoiding the plants before activities occur.

Cumulative effects

The timeframe considered is from 1999 when Arizona sneezeweed was added to the sensitive species list to 20 years in the future. The area of this analysis is the project boundary.

On the Coconino National Forest, Arizona sneezeweed has been addressed in Upper Beaver Creek Watershed Fuel Reduction (2010), Clint's Well Forest Restoration (2013) and the Cragin Watershed Protection Project (2018), in which effects were mitigated through design features and mitigations similar to those proposed in this project. The finding of effect for all of these projects was "may effect". To date, none of these projects has been fully implemented. Therefore the effects of the projects on Arizona sneezeweed including those that would be beneficial to the species have not been fully realized.

Arizona sneezeweed tends to grow in drainages and open areas. These areas are also favored by dispersed recreationists who may crush plants and alter habitat during activities. Activities such as grazing and fuelwood gathering have occurred and would continue in these areas.

Factors contributing to the degradation of aquatic habitats that led to the decision to include the areas in this analysis may have also affected the habitat of Arizona sneezeweed. Aquatic habitat restoration, depending on the actions taken could preserve or improve the habitat of Arizona sneezeweed in this area, depending on the actions taken by restoring the general area and reducing effects such as erosion in the long term.

Determination of Effect

Implementation of Alternative 2 or 3 of the Rim Country EIS may impact individuals of Arizona sneezeweed (*Helenium arizonicum*) but is not likely to result in a trend toward federal listing or loss of viability.

Flagstaff beardtongue (Penstemon nudiflorus)

Flagstaff beardtongue is a Region 3 sensitive species for Coconino National Forest. Flagstaff beardtongue grows in dry pine forests, pine/oak, pine/oak/ juniper and pinyon juniper forests.

Direct and indirect effects

Most of the areas containing Flagstaff beardtongue receiving vegetation treatments areas are proposed for mechanical treatment (goshawk foraging). The effects of mechanical treatment include loss of individual plants or groups of plants.

Prescribed fire would occur across the project area. Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss of shade, increased risk of noxious or invasive weeds and an increased risk of erosion.

An indirect effect of management actions within the potential habitat of Flagstaff beardtongue includes an increased risk of invasion from noxious or invasive weeds.

Activities associated with roads and transportation in this project would be limited to those needed to accomplish the management actions that would occur in the area.

These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

There are no rock pits or in-woods processing areas near the occurrences of Flagstaff beardtongue so there would be no effects from these management activities associated with rock pits or in-woods staging areas.

Cumulative effects

The area of consideration for this discussion includes the Coconino National Forest within the analysis area boundary. The timeframe includes 20 years past and future.

Flagstaff beardtongue occurs on several of past projects that addressed vegetation and prescribed fire treatments. These include Upper Beaver Creek Watershed Fuel Reduction (2011), Clint's Well Forest Restoration, Lake Mary Road ROW Clearing (ADOT) (2016) and the 1st 4FRI EIS. Effects to Flagstaff beardtongue were mitigated with similar measures as those proposed in this DEIS. None of these projects have been fully implemented so the effects to Flagstaff beardtongue, including those that could be beneficial are not fully realized.

Management activities such as grazing have occurred and would continue to occur in the area of consideration. Other activities such as utility corridors have impacted individual plants or groups but has not substantially affected the species as a whole. Activities such as dispersed recreation and fuel wood cutting occur in the area of consideration. Flagstaff beardtongue is showy and is cultivated and offered for sale by local and regional wildflower vendors. The effects of activities such as collection of seeds or plants on wild populations is not known.

Determination of Effect

Implementation of Alternative 2 of the Rim Country EIS may impact individuals of Flagstaff beardtongue (*Penstemon nudiflorus*) but is not likely to result in a trend toward federal listing or loss of viability.

Alternative 3 – Focused Alternative

Arizona Bugbane (Cimicifuga arizonica)

Under alternative 3, no mechanical treatments would take place in the area where Arizona bugbane is known to occur, so the effects of mechanical treatment described in alternative 2 above do not apply. The reduction of canopy closure and reduction of stand densities would not occur in this alternative. The effects on Arizona bugbane of all other management actions are similar to those described above in the discussion of effects of alternative 2.

Hairy Clematis (Arizona leatherflower) (Clematis hirsutissima var. hirsutissima) (syn. var. Arizonica)

In alternative 3, no mechanical or fire treatments are proposed in areas where hairy clematis is known to occur so the effects of those actions are similar to alternative 1, the no action alternative. The effects of transportation and channel restoration are the same as those discussed for alternative 2, above, including the threats of noxious or invasive weeds.

Rock (cliff) fleabane (Erigeron saxatilis)

One occurrence of rock fleabane (in the Barbershop MSO PAC) would not receive mechanical and prescribed fire treatments in this alternative and would not move as quickly toward desired condition as compared to the potential MSO PAC treatment in Alternative 2. Two occurrences that would be treated as MSO habitat in alternative 2 would receive different mechanical treatments in this alternative. One area would receive an individual tree removal and the other would be treated using an uneven age thinning treatment. Both would receive some form of prescribed burning. The effects of these treatments may result in different overstory composition and structure but the effects to rock fleabane and its habitat are expected to be similar.

Arizona sneezeweed (Helenium arizonicum)

Fewer areas containing Arizona sneezeweed would be treated as compared to alternative 2. As a result, alternative 3 would not fulfill the purpose and need of the project as well as alternative 2 and there would be less progress toward the desired conditions of the forest LMRPs, including those that apply to Region 3 sensitive plants such as Arizona sneezeweed.

Flagstaff beardtongue (Penstemon nudiflorus)

Under alternative 3 few acres containing Flagstaff beardtongue would receive vegetation treatments. Alternative 3 would not address the purpose and need to the extent that alternative 2 would. There would be less progress toward the desired conditions that affect Flagstaff beardtongue. Forest resilience and would be attained on fewer acres and the risk of undesirable fire effects would be reduced in fewer areas. Flagstaff beardtongue plants and habitat in these areas would remain at higher risk of loss or

Bebb's Willow (Salix bebbiana)

Fewer areas containing Bebb's willow would receive vegetation or prescribed fire treatments as compared to alternative 2. As a result, it would not fulfill the purpose and need of the project to the extent that alternative 2 would and there would be less progress toward the desired conditions including those that apply to Region 3 sensitive plants such as Bebb's willow.

Noxious and Invasive Weeds

The noxious and invasive weed analysis is part of the Botany and Weeds Report (Crisp 2018), which is incorporated by reference.

Assumptions and Methodology

Assumptions

This analysis is based on the following assumptions.

17. All management activities would occur as analyzed in the various specialists reports and described in the FEIS.
18. The mitigation measures, design features, and Best Management Practices would be incorporated into project design and implementation. See Appendix C for these features.
19. Areas to be treated would be surveyed for noxious or invasive weeds before treatments are implemented.
20. These factors should be considered when identifying survey needs:
    - Likelihood of any of the species addressed in the Botany and Weeds report occurring within the treatment area
    - Amount of disturbance. For example, surveys may not be needed in areas scheduled for prescribed burning if the treatments are scheduled to be of low intensity.
21. The acreage of potential disturbance in this project is much larger than generally analyzed in similar projects, necessitating more noxious or invasive weed treatments to control invasive species.

Affected Environment

Each of the three forests has separate noxious or invasive weed treatment analyses. As a result, the targeted species and treatment methods may differ across forests. The Coconino National Forest was the first of the three forests to complete a noxious or invasive weed treatment analysis the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab, and Prescott National Forests*; (USDA Forest Service 2005), analyzing 29 species for treatment. The Apache-Sitgreaves National Forests completed the *Environmental Assessment for the A-SNFs Integrated Forest-Wide Noxious or Invasive Weed Management Program* (USDA Forest Service 2008). It analyzed 53 species and included a variety of treatments including chemical, cultural, mechanical/physical and biological control. . The Tonto National Forest completed the *Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants* in 2012 and addressed 68 species. It includes manual, mechanical, prescribed burning, cultural, use of biological control agents, and use of herbicides.

Noxious or invasive weeds are present within all three forests in the project area.

Table 98. Noxious or invasive weeds within the project boundary and forest where each species occurs.

Scientific name	Common name	Forest
Acroptilon repens	Russian knapweed	Apache-Sitgreaves, Coconino, Tonto
Alhagi maurorum	camelthorn	Coconino, Tonto
Arundo donax	Giant reed	Tonto
Bothriochloa ischaemum	yellow bluestem	Coconino
Brassica tournefortii	Asian mustard	Tonto
Bromus arvensis (*B. japonicus*)	Japanese brome	Coconino, Tonto
Bromus rubens	Red brome	Tonto
Bromus tectorum	cheatgrass	Coconino, Tonto
Carduus nutans	musk thistle	Apache-Sitgreaves, Coconino, Tonto
Centaurea biebersteinii	spotted knapweed	Coconino
Centaurea diffusa	Diffuse knapweed	Coconino
Centaurea melitensis	Malta starthistle	Tonto
Centaurea solstitialis	yellow star-thistle	Apache-Sitgreaves, Coconino, Tonto
Convolvulus arvensis	Field bindweed	Tonto
Eragrostis curvula	Weeping lovegrass	Tonto
Eragrostis lehmanniana	Lehmann's lovegrass	Tonto
Cirsium vulgare	bull thistle	Apache-Sitgreaves, Coconino, Tonto
Eleagnus angustifolia	Russian olive	Coconino
Erysimum repandum	Spreading wallflower	Tonto
Euphorbia esula	Leafy spurge	Coconino
Linaria dalmatica	Dalmatian toadflax	Coconino, Tonto
Linaria vulgaris	butter and eggs	Apache-Sitgreaves
Onopordum acanthium	Scotch thistle	Coconino, Tonto
Tamarix ramosissima	salt cedar	Apache-Sitgreaves, Coconino, Tonto
Ulmus pumila	Siberian elm	Tonto

Environmental Consequences

Alternative 1 – No Action

There would be no effects to noxious or invasive weeds from management activities because none would occur. Alternative 1 would not increase forest resiliency and sustainability or reduce the risk of undesirable fire effects.

There would be no improvement in terrestrial or aquatic habitats. There would be no surveys for or treatments of noxious or invasive weeds. Survey and treatment would continue in other projects, as part of the forests' noxious weed program, and by other entities such as Arizona Department of Transportation.

Weed infestations that would have been detected and treated would go unnoticed and continue to expand unless detected by other surveys or independent observations. Treatments that would have been part of the mitigating actions not be accomplished. As a result, treatment of weed infestations would not occur unless the locations are included in another project area or are treated by a cooperating agency. For example, treatments along highways or roadways in coordination other agencies would continue but would not expand outside of highway right of ways.

The guidance of past analyses that would allow treatment of noxious or invasive weeds on the forests, specifically the Environmental *Assessment for the A-SNFs Integrated Forest-Wide Noxious or Invasive Weed Management Program,* the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab, and Prescott National Forests* and *the Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants* for Tonto National Forest would not apply.

The design features in appendix C would not be used. These design features provide an integrated approach to noxious or invasive weed management but would not be incorporated into management activities on the forests if the no action alternative is selected.

Effects Common to Alternatives 2 and 3

The purpose of the Rim Country Project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity in ponderosa pine ecosystems to conditions within the natural range of variation. Preventing, controlling, and eradicating noxious or invasive weeds is complementary to the purpose and need and would improve native vegetation composition. Management of noxious or invasive weeds is consistent with the purpose and need because management of them would contribute to the vegetation composition and diversity of the native plant community in the project area.

The action alternatives would move toward the desired conditions for native plant communities and noxious or invasive weed control. Noxious or invasive weed management would be guided by each forest's weed management NEPA. Surveys for noxious or invasive weeds would be conducted before management activities areas and needed treatments would follow the guidance of each forest's noxious or invasive weed assessment. Post implementation monitoring and treatment would occur.

To prevent the introduction and spread of noxious or invasive weeds by vehicles used in management activities, vehicles and equipment would be washed to remove soil, seeds and other debris from them before entering the area or when moving from one area to the other. Ideally, this would occur before the equipment comes onto the forest but it can also be facilitated with the approval of the contracting officer or timber sale administrator.

The direct effects of management activities on noxious or invasive weeds include ground-disturbing activities that have the potential to increase the acreage and/or density of the existing infestations within the project area. Disturbance may contribute to the spread of weeds by eliminating competition from existing vegetation and creating bare ground that is more easily invaded than undisturbed areas. Severe disturbance removes competitive vegetation, alters nutrient composition, and creates bare soil making potential sites for the invasion or spread of noxious or invasive weeds. Examples of management activities that would create localized severe disturbance include burned areas from slash piles, creation of log decks, bare soil created through road reconstruction, decommissioning, temporary road construction, in woods processing areas and rock pits.

Tree removal indirectly affects noxious or invasive weeds by reducing tree canopy and stand density. Treatments that reduce the tree canopy and lower the stand density would affect all understory plants, including noxious or invasive weeds by allowing more sunlight, increasing available nutrients and temporarily decreasing competition. The increased availability of resources and decrease in competition can also provide favorable conditions for noxious or invasive weeds and could increase the size and density of existing populations, especially in areas where weed infestations already exist. These effects are reduced to a non-significant level by incorporating the mitigation measures and design features and by incorporating survey and treatment in the project. Design features which limit the amount of soil disturbance permitted during timber sales and regulate the depth of rutting by vehicles when soil conditions are wet, minimizing soil disturbance, would help reduce the amount of disturbance during operations, reducing the amount of bare ground for noxious or invasive weeds to occupy.

Burning can release nutrients, reduce plant competition, increase the amount of available sunlight and increase bare soil. Most prescribed burning would be of low severity with low soil heating, retention on most ground litter and little or no change in mineral soil. Prescribed or managed fires generally result in lower severity and result in lower levels of noxious or invasive weed invasion as compared to uncontrolled wildfire

Alternatives 2 and 3 would incorporate a series of design features and mitigations that would reduce the risk of increasing weed coverage or extent and decrease the risk of introduction of noxious or invasive weed species not known to exist within the project area. Design features provide for collaboration between resources before the implementation of a prescribed fire. Follow-up monitoring would be conducted in areas of heavy disturbance such as large slash piles. Design features provide direction to conduct prescribed fires under conditions that promote native plant communities, hinder weed species germination, aid with controlling existing weed infestations, and prevent the spread of existing weeds.

Direct and indirect effects of temporary road construction, road reconstruction and maintenance or road decommissioning include disturbance and increased risks of dispersal of existing weed species and populations and introduction of new species. These would be mitigated by following the design features in Appendix C.

Management activities associated with aquatic and channel restoration would increase disturbance in certain areas. These effects would be mitigated by following the design features in Appendix C.

A series of rock or gravel pits would be needed to provide materials for road maintenance in the project area. Appendix C provides a series of design features designed to minimize the risks of introduction and spread of noxious or invasive weeds within the project area.

Processing areas are likely to be locations where invasive weeds are established during their operation. These areas would be managed under the timber sale or special use permit. To minimize the potential for invasive species spread and transport, these would be treated as part of the reclamation once operations are complete. Implementation of the design features would reduce introduction and spread of noxious and invasive weeds. Thus, while these areas would result in localized weed populations, the spread is expected to be limited. Design features provides for rehabilitation of processing areas after they are no longer used including seeding of sites with native seed which would help re-establish native plant communities and reduce the risk if noxious or invasive weed infestations. Seed mixes of native species used for post-thinning erosion would be certified as weed-free in accordance with Region 3s guidance for weed-free materials (USDA 2018) with a minimum of five pounds of pure live seed per acre (USDA 2018).

Alternatives 2 and 3 are expected to limit the establishment and spread of invasive species within and adjacent to the project area over the next several decades by decreasing the risk of high severity wildfires which are generally sources of severe disturbance. By decreasing fire severity, these alternatives would result in increased understory abundance and diversity which would be more resistant to invasive species over the next 10 to 20 years.

Cumulative Effects

The cumulative effects analysis area for noxious or invasive weeds includes the project area plus surrounding major arteries of transportation and utility corridors that enter the project area.

Major roads and utility corridors were included because of their roles in providing corridors for dispersal of noxious or invasive weeds. The timeframe for cumulative effects on noxious or invasive weeds is twenty years prior and twenty years into the future.

The distribution of noxious or invasive weeds on the project has been shaped by past management activities and natural disturbances in the project area. Activities such as firewood cutting have occurred in the past and would continue into the future. Fuel wood cutters can introduce weeds into the area through their actions. These actions occur under permit but the forests have limited control over where these activities would occur.

Wildfires are sources of high levels of disturbance depending on fire severity. Severely disturbed areas can be more easily invaded by noxious or invasive weeds than less severely disturbed or undisturbed areas. Numerous wildfires have occurred in the project area (see cumulative effects document). Some of these, such as the Rodeo-Chediski (2002), Juniper (2016) and Pot Fire (1996) have covered large acreages. These have resulted in large acreages of severe fire effects such as almost complete removal of the plant communities and soil erosion, leaving large areas of disturbance prone to noxious or invasive weed invasions. Some remedial actions for large fires have resulted in large acreages of non-native species that are now problematic and would be challenging to restore to native plant communities.

Past fire exclusion has contributed to the risk of noxious or invasive weed invasion by promoting very dense forests with little or no resilient understory community that would normally compete with noxious or invasive weeds. Fire exclusion also increases the risk of severe stand replacing fires and its accompanying severe disturbance.

There are numerous grazing allotments in the project boundary. The past effects of grazing and the associated activities are not completely known but may include temporary reduction of the native plant community in certain areas (especially near water sources) which would allow for plants such as the noxious or invasive weeds to enter the plant community through feed or manure.

A wide variety of recreation activities occur within the boundary of the project area including hiking, camping, hunting and recreational driving. Users can introduce noxious or invasive weeds from other areas on vehicles and personal equipment. The effects of livestock such as horses or pack animals used in recreation are similar to those in grazing and include temporary reduction of the native plant community in localized areas where animals are allowed to graze and introduction of weeds through feed or manure. Trampling and compaction can also occur if the same campsites are used repeatedly.

In the past there were few restrictions on off-road motorized travel whether for recreational or other purposes but these actions are now regulated through implementation of the Travel Management Rule on the forests. This reduces the risk of introduction of noxious or invasive weeds and reduces vehicle damage to existing vegetation and habitat.

Major highways tend to be corridors for weed dispersal by providing a source to vector weeds into the area. Management activities associated with the highways create disturbance and spread existing weeds. Examples include past activities such as blading of road ditches where equipment passed through existing weed infestations, spreading them along the road corridor. In 2003, the Southwestern Region of the Forest Service completed the Environmental Assessment for Management of Noxious Weeds and

Hazardous Vegetation on Public Roads on National Forest System Lands in Arizona. The decision, which followed in 2004, allowing treatment of noxious or invasive weeds along state and federal highway rights-of-way through all National Forests in Arizona. Some treatments have occurred along state and federal highways as a result but the extent of these treatments are not known.

The Apache-Sitgreaves National Forests has surveyed and treated numerous infestations of noxious or invasive weeds within the project area since 2004. All of the treatments prior to the approval of the *Environmental Assessment for the A-SNFs Integrated Forest-Wide Noxious or Invasive Weed Management Program* (USDA Forest Service 2008) were mechanical treatments accomplished using hand tools. Herbicide use on the forest began in 2009 after the approval of the document.

The Coconino National Forest began weed survey and treatments in about 1995 and like the Apache-Sitgreaves, they relied on non-herbicide methods to control isolated occurrences using mechanical control and alternatives such as grazing. Using sheep to control leafy spurge was utilized before the approval of the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab, and Prescott National Forests*; (USDA Forest Service 2005). The EIS allowed use of herbicide as well as biological control.

There are records of surveys along roadways on the Tonto National Forest beginning in 1999. These surveys were generally by Arizona Department of Transportation. The forest began surveying for weeds in 2003. Many of the treatment prior to the approval of the *Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants* (2012) were done using hand tools.

The disturbance resulting from the management activities in this project would continue to be sources of disturbance that may contribute to the threat of noxious or invasive weed occurrences and would be additive to the activities discussed in this section of the report.

Recreation

A summary of the Recreation Report is presented here and the specialist report (Wright 2018) is incorporated by reference. The potential effects of the 4FRI Rim Country Project on recreational opportunities was not raised as a concern by the public.

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Affected Environment

Recreation Trends

The Apache-Sitgreaves, Coconino, and Tonto National Forests provide diverse outdoor recreation opportunities connecting people with nature in a variety of settings. Forest users can hike, bike, drive motorized vehicles, camp, fish, view wildlife and scenery, and explore historic and prehistoric places. They enjoy opportunities for year-round recreation activities from birding and wild flower observing in the spring, hiking in summer months, fall color viewing and hunting, to cross country skiing in the winter.

Forest users may occasionally experience short-term or temporary disruptions in their recreation activities as a result of other groups currently occupying a preferred site, forest management activities such as current thinning or prescribed fire projects, fire restrictions or fire closures due to hot, dry weather and extreme fire danger, as well as natural occurrences such as fallen trees blocking a roadway or trail, and so on. When asked how visitors would react to such disruptions in their plans, they reported in the National Visitor Use Monitoring survey (NVUM) using substitution behaviors such as coming back another time, going elsewhere for a different activity, going elsewhere for the same activity, going to work, some other substitution or staying at home (USDA 2016- 2017). The number one response for all three Rim Country forests was by far going elsewhere for the same activity.

Demographic shifts and lifestyle changes have affected the demand for recreation opportunities on national forests. Today about 80 percent of the population lives in urban settings and may not have the same values as rural residents who live closer to or may depend on natural resources for their livelihood (Forest Service 2010). Both of these trends have created challenges to Forest Service recreation managers to meet demands for an ever-increasing number of recreation users as well as a diverse number of desired recreation activities. Population growth is expected to continue into the future and will increasingly affect national forest management activities, as well as ability to provide satisfying recreation opportunities.

The NVUM data highlights that the Coconino National Forest is the most popular national forest in the southwestern region, but the data also shows that the forest serves an interesting niche. The Coconino National Forest is heavily used by non-local and international visitors; it is estimated that 60 percent of the 4.7 million visitors come a long distance (over 100 miles) to visit the national forest (USDA Forest Service, 2018). While the Apache-Sitgreaves National Forests serves a higher percentage of visitors coming from more than 100 miles with 70 percent, both forests are visited by about 30 percent of local visitors. The Tonto National Forest is mostly visited by locals, with about 74 percent of visits coming from less than 50 miles away. Large numbers of visitors come from areas (primarily the Phoenix metropolitan area) to visit the area largely for the change of scenery, ideal climate, and relief from extreme summer temperatures in nearby major metropolitan areas. The Rim Country project area covers a wide array of recreationists coming from different places within Arizona and from other states and countries. This reflects the desire of many recreationist to participate in the extensive possibilities of recreation activities in the area.

Recreation Activities within the Project Area

There are a number of Forest Service trails and developed recreation facilities within the Rim Country analysis area, including developed campgrounds. Most of the recreation facilities are located on the Apache-Sitgreaves National Forests.

There are 30 developed campgrounds in the Rim Country project area. Campgrounds generally operate from May to October depending on weather. These campgrounds see high use on weekends typically from mid-May to mid-September.

There is a total of 728 miles of trail identified in the project area. The Apache-Sitgreaves National Forests contain the most miles of trail, with more than double that of the Coconino and Tonto National Forests. In addition, the Apache-Sitgreaves is the only forest to have snow trails. The project includes part of the Arizona National Scenic Trail, the General George Crook National Recreation Trail, the Blue Ridge Recreation Trail and the Highline National Recreation Trail.

There are currently no designated segments of wild and scenic rivers in the Rim Country project area. There are however, currently 9 segments of eligible wild and scenic rivers on the Apache-Sitgreaves and Coconino National Forest in the project area. In addition, as part of its forest plan revision process, the Tonto National Forest is completing an updated eligibility report for wild and scenic rivers to replace the existing eligibility report from 1993. To ensure compliance with current forest plan direction, this analysis includes both the eligible rivers reported in the 1993 study, as well as those listed in the current draft eligibility report.

Dispersed recreation includes the full suite of outdoor non-motorized and motorized recreation opportunities available throughout the year. Dispersed camping requires no additional facilities other than road or trail access, though the relatively unconstrained nature of dispersed camping can cause resource impacts such as soil compaction and erosion, loss of vegetation, increased fire risk, displacement of wildlife, and accumulation of trash and human waste. The number of dispersed campers in the analysis area is also difficult to estimate.

As Arizona's population has grown, the state has also seen a dramatic increase in ownership and use of personal off-highway vehicles (OHVs). Arizona Trails 2010 reported a 623 percent increase in sales of off-highway motorcycles and all-terrain vehicles (ATVs) in Arizona between the years 1995 to 2006 (McVay et al. 2010).

The 2013 Arizona Statewide Comprehensive Outdoor Recreation Plan reports that based on the Arizona Trails 2010 Plan, OHV users represent almost 22 percent of the Arizona population, which includes residents who use motorized vehicles on trails for multiple purposes. Of that, 11 percent of Arizona residents reported that motorized trail use accounted for the majority of their use and are considered "core users." With Phoenix and surrounding communities being among the fastest growing populations in the state, adjacent forest areas can expect a large increase in visitation.

In November 2005, the Forest Service announced new federal regulations called the Travel Management Rule, requiring each national forest to establish a designated system of roads, trails, and areas by vehicle type and time of year. Designated roads, trails, and areas would then be identified on a Motor Vehicle Use Map, made available to the public for free (36 CFR 212.56).

The 4FRI Rim Country Project would adhere to the current Travel Management Rule decisions for the Coconino, Tonto, and Apache-Sitgreaves National Forests.

The Forest Service uses the Recreation Opportunity Spectrum (ROS) to provide a framework for defining classes of outdoor recreation environments, activities, and experience opportunities (USDA Forest Service, ROS Primer and Field Guide 2011). The ROS is a land classification system that categorizes national forest land into six classes, each class being defined by its setting and by the desired opportunities and characteristics the setting offers. The six ROS classes are Primitive (P), Semi-Primitive Non-Motorized (SPNM), Semi-Primitive Motorized (SPM), Roaded Natural (RN), Rural (R), and Urban (U). There are no wilderness or recommended designated wilderness area within the proposed project. Opportunities for experiences along the spectrum represent a range from very high probability of solitude, self-reliance, challenge and risk, to a very social experience where self-reliance, challenge and risk are relatively unimportant.

The purpose of the ROS is to identify desired conditions across the Forest so that different parts of the forest may facilitate different recreational experiences. The ROS represents management objectives, which may not always reflect actual user experiences. The large majority of the Rim Country project area falls into the SPM and RN classes. Approximately 418,680 acres or 35 percent of the project area is SPM. RN makes up 418,675 acres or 50 percent, and SPNM makes up 13 percent of the area. The recent revised forest plans for the Coconino and the Apache-Sitgreaves National Forests contain updated ROS maps that represent the desired conditions for ROS classes across the forests. Not all acres on the forests currently meet these desired conditions. The desired conditions are meant to guide project design, alternative development, and assessment of potential project effects. ROS classifications are also used to determine if project activities would help move toward desired conditions for recreation opportunities at the forest level.

All three national forests in the project area offer numerous developed recreation opportunities as illustrated in Figure 87. The Rim Country Project does not include restoration activities in developed recreation sites, special areas, or designated Wilderness. Outside of these areas, many forest users engage in dispersed recreation including hiking, dispersed camping, driving motorized vehicles, rock climbing, cross-country skiing, and snow play. There may be restoration activities in many places where dispersed recreation occurs.

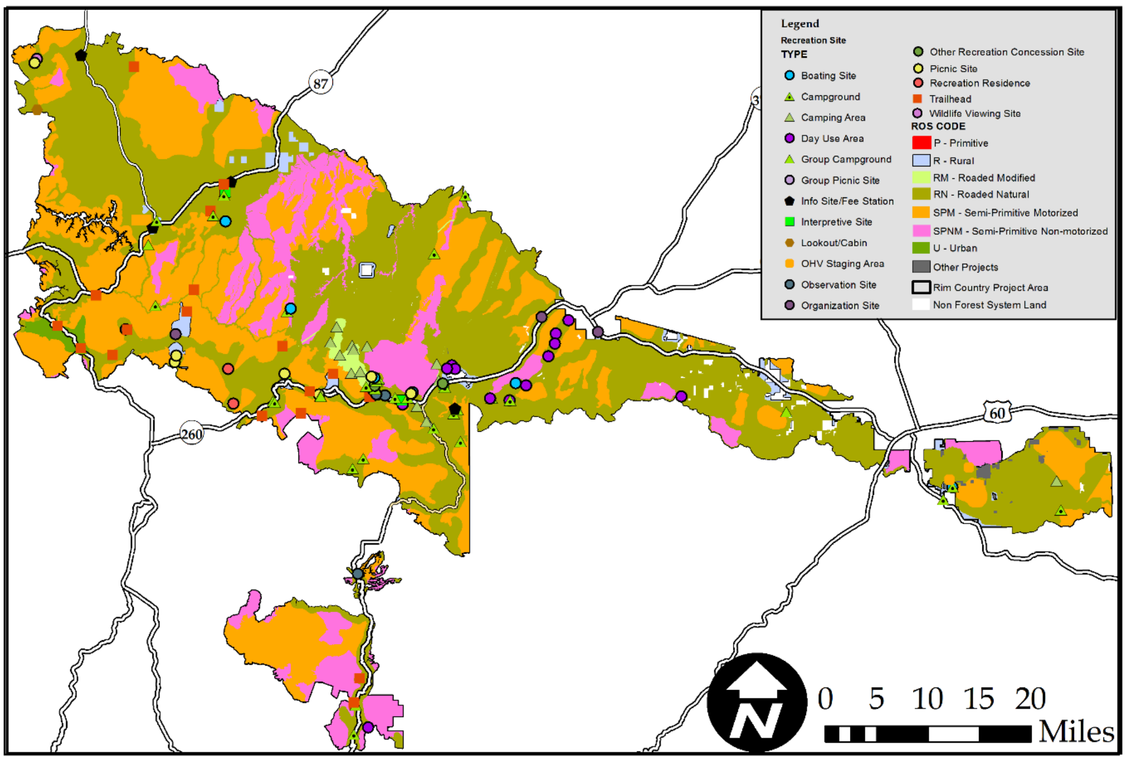

Figure 87. Rim Country developed recreation sites

A spectrum of high-quality outdoor recreation settings and opportunities would be made available in the project area.

Management activities on National Forest System lands are consistent with recreation setting objectives that provide opportunities for the public to engage in a variety of developed and dispersed recreational activities, in concert with other resource management and protection needs.

Assumptions and Methodology

This assessment includes use of the best available science, based on relevant peer-reviewed literature, published reports from regulatory and land management agencies, existing resource inventories, field visits, and the professional judgment of interdisciplinary and cooperating agency team members.

The Recreation Opportunity Spectrum (ROS) is the guiding system that forest plans direct be considered when planning projects to properly manage and balance recreation opportunities. The ROS provides a framework to assist managers in identifying different outdoor recreation environments, settings, activities, and experiences desired by the public, and deciding how to provide these different recreational opportunities over the landscape within the forest (USDA Forest Service, ROS Book, 1986). ROS classifications are identified to distinguish the desired conditions across the landscape. ROS classifications within the project area were referenced to determine if project activities would affect the potential for meeting or moving toward desired conditions identified in the ROS classifications.

The Special Uses Database System was used to generate a list of all recreation special use authorizations within the project area. This report was sorted by status. The authorizations were considered part of the existing condition if they had statuses of application accepted, pending signature, or issued.

Data and experiences from both the 4FRI first EIS and the Cragin Watershed Protection Project were used in this analysis because of proximity to the project area, probability that users would recreate in all these project areas, and the similarity of terrain and vegetation.

The timeframes for direct and indirect effects include the potential for up to 20 years of project implementation. The thinning treatments may take up to 20 years to complete, with each thinning contract generally completed within a three-year timeframe. Implementation may include prescribed burning over a 20-year period, with multiple burn intervals of two to 10 years across the project area. Any direct or indirect effects related to the recreationists' scenery perceptive are described in the scenery report.

Issues/Indicators/Analysis Topics

Analysis topics identified relative to recreation and lands management resources are based on Forest Plan desired conditions, management approaches, guidelines, and standards. There were very few public comments identifying issues or concerns related to recreation, except for potential effects from treatments on the Arizona National Scenic Trail and its users. Consequently, this resource area was determined to require cursory analysis. The primary issue of concern to recreation resources from the proposed activities is to minimize and mitigate impacts to recreation features (for example, developed campgrounds, signs, trails, and trailheads) and recreation activities (for example, driving for pleasure, dispersed camping, hiking, mountain biking, equestrian use, hunting, boating, special use events, and developed camping)..

Environmental Consequences

Alternative 1 – No Action

Under this alternative, recreation resources would be managed as they are currently without any effects from vegetation treatments and prescribed burning proposed in the Rim Country project area. Although electing the no action alternative would not result in impacts to these resources from prescribed burning or thinning, this alternative would not reduce the risk of uncharacteristic wildfire that could cause important resource damage, damage to recreation and lands infrastructure, and subsequent flooding. Wildfires ignited by lightening could be managed for resource benefit given conditions allow; however, the use of this strategy to decrease future crown-fire risk is unpredictable and unlikely to affect a majority of the project area. Alternative 1 is the point of reference for assessing action alternatives 2 and 3.

This alternative would contribute to the same risks identified as indirect effects. The increased risk of uncharacteristic wildfire resulting from this alternative would contribute to the issue of limited recreational access and opportunities on the national forests. Over the last several years, there have been a number of large high-intensity wildfires such as the Wallow Fire, General Fire, which have resulted in area closures and loss of temporary access and recreational use. Given an increasing likelihood of wildfire and a greater likelihood of high-intensity wildfire throughout the southwest under predicted climate change scenarios, the increased risk of wildfire, this alternative would result in a cumulative increase of these effects of risk to permitted infrastructure, limited recreational access, and loss of recreational opportunities and access in project area and surrounding areas. This alternative would also cumulatively combine with the increasing risk of high intensity fire from climate change and result in an elevated risk to lands and events managed under short-term or long-term special use permits.

Recreation Sites and Uses

Recreation Resources

The threat of uncharacteristically severe wildfire continues to increase with ongoing, unmanaged growth of vegetation. Uncharacteristic wildfire would severely influence recreation values and experiences in the analysis area. Research has demonstrated the negative effects wildfire can have on recreation activities. Vaux, et al. (1984) found that "intense fires may have detrimental effects on recreation values" (p.1).

During NVUM, visitors were asked what they would do if they were unable to visit this national forest due, for example, to closures related to wildfire damage and rehabilitation. The majority of visitors responded that they would have gone elsewhere for the same activity. This suggests that if the Rim Country project area was closed due to wildfire or related effects, visitors would seek alternative locations to enjoy the same recreation activities. This could lead to overcrowding in nearby areas, resulting in resource damage and undesirable recreational experiences.

Developed Recreation Facilities

Developed recreation facilities, such as campgrounds and group event sites, could be negatively affected if there is no action to reduce the risk of uncharacteristic wildfire. The changes to landscape character and visual quality following a severe fire would considerably diminish the quality of recreation experiences and activities in affected areas. Effects from severe wildfire on other recreation-related infrastructure such as restrooms, kiosks, bulletin boards, and trail signs would be substantial and would result in high costs to repair or replace damaged facilities. Historic sites such as lookout towers and guard stations could not be replaced if destroyed.

Trails

The Rim Country project area contains parts of four national trails: the Arizona National Scenic Trail (70 miles in the project area), the entire Blue Ridge National Recreation Trail (9.4 miles), the General Crook National Recreation Trail (95 miles in the project area), and the Highline National Recreation Trail (44 miles in the project area). Figure 89 illustrates the locations of the national trails in the project area. The Rim Country project area contains 728 miles of trail, ranging from most primitive to fully developed. Some trails in the Rim Country project area share characteristics with the trails that were damaged in the Schultz Fire. Wildfire or flood damage to segments of trails within the project area would require closures of affected sections until they could be properly repaired and determined safe for use. In the interim, potentially lengthy re-routes would have to be established for visitors wishing to hike any affected trails, especially for the state-wide Arizona National Scenic Trail.

While short-term effects of uncharacteristic wildfires on recreation are almost uniformly negative, longer-term effects may differentially impact certain user groups. Fire-damaged trees can take many years to fall, and it is likely that any affected trail system would experience increased numbers of downed trees across trails for many years, despite routine maintenance. Crossing downed logs on trails is more burdensome for mountain bikers, who must stop, dismount, and lift their bikes over fallen trees, than it is for hikers, who may be able to simply step over these obstacles. Hesseln, et al. (2003) found that the value of net benefits for hikers increased during the 40 years following crown fire, whereas the net benefits for mountain bikers declined over the same period. This demonstrates that different intensity fires may impact groups engaged in different recreation activities in different ways.

Overall trail users respond negatively and have a decreased return to forested areas that have experienced uncharacteristic wildfire. “The lack of mature trees and the large numbers of downed trees make the area unattractive to hikers and mountain bikers” (Starbuck et al. 2006, p. 63). So the no action alternative which has no vegetation management activities or prescribed burning treatments to reduce the risk of wildfire could have negative effects on trails and trail users if an uncharacteristic wildfire was to occur in the Rim Country project area.

Wild and Scenic River

There would be no effect on the Wild and Scenic Rivers as they would continue their management per the direction in the respective Forest Plans.

Dispersed Recreation

Following the Rodeo-Chediski Fire in 2002, dispersed camping in the burned area was prohibited for nearly seven years. The major reasons for this restriction was to protect visitors and property from damage due to falling trees and flooding, and to reduce recreation effects to fragile fire-damaged soils. The time it takes a fire-damaged tree to fall is unpredictable and depends on several factors including weather, topography, burn severity, and flooding. Trees that have been killed or damaged by fire may be unstable and parts or all of such trees can easily become dislodged and can fall onto forest visitors, vehicles, or camping equipment.

Dispersed camping is popular in the Rim Country project area and an uncharacteristic wildfire could result in closing a fire area to camping and other activities. This would impact thousands of visitors every summer that visit the project area to camp in the desirable summer temperatures. Should a wildfire result in large, long-term closures for safety or resource protection purposes, activities such as camping, hunting, and other recreational uses would be lost or severely degraded during both short-term (one to five years) and long-term (five years or more) timeframes.

Recreation Special Uses

Although the no action alternative would not produce any effects from vegetation management or prescribed burning on recreation special use activities, the risk of uncharacteristic wildfire would not be reduced. Uncharacteristic wildfire could impact recreation special uses because sites (recreation events) would likely be unsafe and less appealing for recreation special use activities after such a fire and would likely result in closures (short-term and long-term) depending on severity.

Effects on recreation residences at Diamond Point and Elison Creek, and organization camps including Camp Shadow Pines, Tall Timbers County Park, Arizona Cactus-Pine Girl Scout Camp, and Grand Canyon Council Boy Scout Camp could be extreme. In similar post-wildfire situations, such as after the 2005 Cave Creek Complex Fire on the Tonto National Forest, recreation residences were destroyed by wildfire. After five years of planning, 10 residences were approved for reconstruction and the permits for three residences were either revoked or expired without renewal. Thus, this alternative could result in a long-term decrease in recreational use and opportunity in the project area.

Motor Vehicle Use

Motorized Travel Management implementation in combination with the no action alternative is expected to have no effects on recreation settings. Present and future activities may result in degradation along heavily used camping corridors, but these would be small and localized.

Recreation Opportunity Spectrum

ROS would remain within forest plan guidelines unless stand-replacement wildfire affects a large portion of the analysis area. Locations and results of unplanned fire ignitions are impossible to predict; however, it is likely that an uncharacteristic wildfire would move conditions away from desired conditions for semi-primitive areas where the evidence of humans is meant to be limited (semi-primitive areas). Uncharacteristic wildfire would likely include a number of alterations to the forest environment such as cutting of dead roadside hazard trees, increased signage to warn of post-fire dangers, re-constructed roads, or recently constructed dozer or hand-built fire line. All of these would result in short and some long-term effects that would move conditions away from desired conditions identified for semi-primitive areas.

Effects Common to Both Action Alternatives

Developed Sites

Mechanical and prescribed fire treatments could negatively affect developed recreation sites. However, developed recreation sites would not be modified by any alternatives, as design features have been developed to protect the sites from possible negative effects from proposed treatments in Alternatives 2 and 3.

Recreation Special Use

None of the alternatives would have any effects from vegetation management or prescribed burning on Recreation Special Use activities. All permittees can execute their business as intended by their authorized special use permits.

Effects Unique to Each Action Alternative and Differences among Them

The Modified Proposed Action and the Focused Alternative, which include different amounts of thinning and prescribed burning, would reduce the risk of extensive crown fire and uncharacteristic wildfire. These alternatives would protect the developed campgrounds, lands infrastructure, trails, and dispersed recreation areas within the project area, maintaining open recreation areas and activities for users during and in the years following the project implementation. Shorter-term impacts would occur to uses during implementation, including the potential impacts from larger processing sites near residences, highways, and dispersed recreation areas.

In the long term, the Modified Proposed Action would support the health and safety of recreationalists and surrounding communities, as well as reduce potential effects on water supplies, utilities, and other infrastructure within and adjacent to the project area.

Trails

Overall, trail users respond negatively and have a decreased return to forested areas that have experienced uncharacteristic wildfire. Trail users would be minimally affected by the proposed treatments in both Alternatives 2 and 3 since design features are developed to mitigate any issues related to trails. Effects like visitor displacement and possible overcrowding of some areas where visitors choose to go instead of areas closed or disturbed by proposed treatments are difficult to estimate. However, all three alternatives present different possibilities of risks of uncharacteristic wildfires. Alternative 2 has the lowest risk because of its sizeable amount of acres treated. Alternative 3 would have lower risk than the no action alternative and higher risks than the Modified Proposed Action. The greatest effects on trails would result from uncharacteristic wildfires. This risk can be reduced with proposed treatments. Alternative 1 poses the greatest threat to the trail systems, followed by Alternative 3. The Modified Proposed Action

(Alternative 2) offers the best possible outcome for the current and future use of the trail systems, treating the most acres of forest.

Dispersed Recreation and Motor Vehicle Use

Dispersed recreation and motor vehicle use display the same effects from Alternatives 2 and 3, while. Alternatives 2 and 3 might result in some reduction of recreation opportunities during active forest thinning and prescribed burning, and potentially longer slash treatment duration. Areas may be closed to the public due to hazardous conditions, which would result in forest user displacement and user dissatisfaction. There could also be an increase in crowding in nearby open forest areas.

Alternatives 2 and 3 propose to decommission 200 miles of existing system and unauthorized roads on the Coconino and Apache-Sitgreaves National Forests and 290 miles on the Tonto National Forest. In addition, up to 800 miles of unauthorized roads on all three forests could be decommissioned under these alternatives. The Rim Country Project would adhere to the travel management decisions for the Coconino, Tonto, and Apache-Sitgreaves National Forests. Design features would address any issues related to the construction of temporary roads for haul access, insuring decommissioning of all temporary roads after treatments are completed. Hence, both alternatives would reduce access or ease of access to recreate in certain areas on the forests. However, decommissioning unauthorized roads could positively affect recreation resources by protecting resources and removing access to motorized recreation where unlawful.

Alternatives 2 and 3 would have similar effects, but would vary proportionally with treatment area size. Minor effects would be mitigated through design features.

Recreation Opportunity Spectrum

Alternatives 2 and 3 might cause temporary effects on recreation users at particular areas during implementation activities, mainly thinning operations and hauling. There would be longer term potential effects of increased traffic and noise near processing site locations. However, since most of the project area is located within Roaded Natural, Semi-Primitive Motorized, and to a lesser amount Semi-Primitive Non-Motorized ROS settings, these effects would be consistent with recreation opportunity objective settings for the majority of the project area.

Alternative 2 – Modified Proposed Action

Recreation Sites and Uses

Developed Sites

Any vegetation treatments or prescribed burning in developed recreation sites would generally occur in fall, winter, or spring, which are low-use recreational periods. All treatments in recreation sites would be designed to protect and enhance existing vegetative structure, while maintaining the character of the site. Proposed mechanical treatments and prescribed fire adjacent to developed recreation sites must be reviewed and approved by the district ranger. The district recreation staff may help determine boundaries or no treatment zones around constructed features that need to be protected in campgrounds. Treatments around the perimeter of campgrounds are encouraged. The timing of treatments must be worked out with districts. Treatments would generally avoid summer. Activity slash must be piled in agreed upon locations, and treated as soon as possible. If campgrounds remain open into fall and winter, provide information about upcoming closures and management activities on-site, at Forest Service offices, and on Forest Service websites (see recreation design features in Appendix C).

Facilities at developed sites and campgrounds in the project area would be protected from adverse effects from management activities, and such treatments would protect the developed sites from any short or long-term risk of uncharacteristic wildfire.

Trails

Trail use level is not expected to change. The Modified Proposed Action includes prescribed burning and thinning activities adjacent to the Arizona National Scenic Trail, Highline Recreation Trail, and General Crook National Recreation Trail. Trails within the project area may be temporarily closed during prescribed burning activities but, throughout project implementation, trails and trail infrastructure would be considered and protected, and effects on scenic qualities minimized to the extent practicable. Damage to trails or necessary trail maintenance resulting from prescribed burning or mechanical treatments in the area would be rehabilitated as soon as possible.

In the Modified Proposed Action, mechanical thinning activities would avoid national and forest system trails if possible. Coordination with district recreation planners, trails specialists, and local trail stewards would occur during prescription or burn plan development, layout, marking, thinning, and burning where any treatment would occur on, adjacent to, or near national and system trails. This is to ensure that trails and trail infrastructure are considered and protected and effects on scenic qualities are minimized to the extent practicable. If trails were temporarily closed due to thinning, trails would be returned to pre-treatment conditions (see recreation design features in Appendix C).

Skidding of felled trees would avoid national and forest system trails, if possible, except where motorized use is already authorized (trails located on open system and administrative roads). If it were determined necessary that a trail must be used as a skid trail crossing, perpendicular trail crossings would be used. Trail crossing locations, including those on the Arizona National Scenic Trail and the General Crook and Highline National Recreation Trails would be designated and flagged with input from district trails specialists, recreation planners, or archaeologists. Trails would be restored to Forest Service standards (pre-project condition) following treatment.

There would be no use of motorized equipment on national scenic and recreation trails, or other forest system trails. If these were used for control lines, the district recreation staff would help coordinate the implementation. Where new temporary roads intersect existing roads or trails, native materials such as logs, slash, and/or boulders would be placed along the temporary road to line-of-sight or first 300 feet, whichever is greater.

Road closures, one-way traffic, and area closure restrictions would be implemented as deemed necessary by forest officials for health and safety concerns during any operation. Signs would be placed at major intersections on hauling routes during periods of active hauling. If it is necessary to close forest roads or areas of the forest, notices and signs would be posted at key locations adjacent to and within the project area, such as along major Forest Service roads accessing the area or on kiosks at trailheads, bulletin boards, electronic sign boards. Closures due to operations would also be posted online and on social media as well as being publicized via news releases. Coordination is required with district recreation planners or trails specialists to ensure well-marked and publicized detour routes for the Arizona Trail, General Crook Trail, Highline Trail, and system trails during operational closures.

Dispersed Recreation

Vegetation treatments, prescribed burning, and fuel treatments, occurring over time and space, would have little effect on the recreating public. Alternative 2 would support the re-integration of low-intensity fire as a regulatory process on the landscape. Several cases show low-intensity wildland fires yielding virtually no effects on recreational value and in some instances imparting positive social impacts. Both Sanchez et al. (Sanchez, 2016) and Starbuck et al. (2006) show visitations in California and New Mexico increasing under low-intensity fire scenarios. The only anticipated effect that the Modified Proposed Action would have on dispersed recreation is when prescribed burning coincides with hunting seasons, especially in the fall of the year, or during brief closures of campsites, roads, or trails.

There may also be temporary area closures while prescribed burns are being implemented and, less often, closures for managed fire activities. Spring burning would affect fewer people using dispersed campsites. In total, the action alternatives are not expected to considerably affect dispersed recreation within the project area. Treatments would be planned to be staggered throughout the project area in both time and space, so that even during temporary closures from active treatments, there would be many other places to hunt, camp and recreate. Efforts would be taken to limit forest treatment activities within the project area during high-use weekends and holidays, such as Memorial Day, Independence Day, and Labor Day, especially in locations where concentrated use is expected to occur.

Temporary closures from treatments would result in the temporary loss of recreational access or opportunities and could result in decreased satisfaction of nearby recreational sites where there is overcrowding. This is most likely to occur during high-traffic weekends from Memorial Day through Labor Day, which often includes heavy use of dispersed camping sites within the project area. It can also occur during hunting season.

The transportation system proposed for use under Alternative 2 utilizes a combination of existing Forest Service system roads, improved existing non-system roads, and new temporary roads. No new permanent roads are proposed. Road use during the project for hauling and prescribed burning would affect dispersed recreational uses such as OHV riding where project activities occur on MVUM open roads. Dispersed camping areas along open roads that are being used for implementation may be affected by noise and dust.

There may be temporary road closures enacted during thinning operations or prescribed burning, but these closures would be short term for burning and mainly on Forest Service administrative use roads. The effects from disturbance and closure would be a minor effect on dispersed recreational uses, because they would be of limited duration and there would be many other open areas to camp and recreate during this time.

Spring restoration and improvements would improve the resilience of these areas and make them more attractive to dispersed recreationists. Water in the Southwest is a rare feature, and people are attracted to it for recreation activities including hiking, picnicking, camping, scenery, wildlife and wildflower viewing.

Recreation Special Uses

The Modified Proposed Action would reduce the risk of uncharacteristic wildfire in areas with recreation special uses activities. Coordinated efforts would be made with sponsors of recreational special-use events such as running or mountain biking races, to minimize the effects of such proceedings during Rim Country project implementation. Appropriate signage would be used to inform the public of thinning or prescribed burning activities. The Modified Proposed Action would allow for continued recreation special use activities at current levels throughout the project area during and beyond the timeframe of project implementation.

Wild and Scenic River

Proposed treatments would have no effect under alternative 2 on the Wild and Scenic Rivers. All possible effects would be addressed as per the design features, best management practices and mitigations per Appendix C (Design Features).

Motor Vehicle Use

There would be log truck and other activity-related traffic on the designated road system, although not all roads would be used as haul routes. Hauling would not occur on all roads at the same time. Recreationists could expect increased noise, dust, and traffic on some haul routes.

Approximately 150 miles of existing non-system roads would be reconstructed or improved as part of project implementation.

There would be short-term disturbance and temporary changes in ROS classes and roadside recreation settings during road improvement activities. Recreation visitors may be inconvenienced and have to wait during some activities, or roads may be temporarily closed causing displacement. Road relocation would result in a safer road to travel on. It would also result in short-term disturbances such as increased bare ground and decreased roadside visual quality in scattered locations. Long-term effects would be improved water quality at stream crossings, and safer and better-maintained roads for forest user enjoyment.

Road decommissioning would occur on approximately 200 miles of existing system roads on the Coconino and Apache-Sitgreaves National Forests and approximately 290 miles of roads on the Tonto National Forest. Up to 800 miles of unauthorized roads on all three forests could be decommissioned under this alternative.

Short-term effects of road decommissioning would include ground disturbance and sedimentation and noise disturbance to recreationists. Short-term effects would last from three to 10 years as the project activities rotate across the landscape. There would be a long-term improvement of recreation settings as vegetation is established, soil erosion is minimized, and there is decreased disturbance from motorized vehicles. Once recovered, these former routes are often not apparent to the casual user. Decommissioning 200 miles of roads would improve recreation settings over time and would improve ROS classes, especially in the semi-primitive non-motorized ROS class where all 85 miles of haul routes would be decommissioned.

About 330 miles of temporary roads for haul access would be constructed to support restoration activities. Construction may include tree removal, ground disturbance, and installation of drainage structures, road blading, and other disturbances. Following implementation, the temporary roads would be obliterated using techniques noted for road decommissioning. Temporary road construction would result in short-term disturbance. When possible, there would be relocation and reconstruction of existing open roads adversely affecting water quality and natural resources, or of concern to human safety. This would have long term-positive effects on water quality, natural resources, and human safety.

There may be some increase in illegal motorized vehicle use of these roads until they are decommissioned. Once these roads have been decommissioned, they are usually not apparent to the casual user. Mitigation measures would be used to close off entrance and exit locations of these roads, as well as the use of Best Management Practices (BMPs) (see Appendix C).

Recreation Opportunity Spectrum

There may be temporary effects on recreation users at particular areas during implementation activities, mainly harvesting operations and hauling. There would be longer term potential effects from increased traffic and noise near processing site locations. However, since most of the project area is located within Roaded Natural and a small amount of Rural ROS settings, these effects would be consistent with recreation opportunity objective settings for the majority of the project area.

Construction of all new temporary roads would be similar to a primitive, native surface road that would be cleared and opened for short-term use during thinning and hauling operations. The construction and use would be consistent with the RN or SPM designations and, after use; the temporary road would be completely rehabilitated and would become naturalized within several years after use. The very slight encumbrance of the SPNM area would likely not result in long-term effects to the ability of the area to meet SPNM characteristics over the long term.

Mechanical treatments would primarily occur in RN (50 percent) and SPM (35 percent) areas, with a lesser amount occurring in SPNM (13 percent) in the project area. Mechanical treatments would be expected to result in short-term effects (one to two years after treatment) where the sights and sounds of humans are more noticeable on the landscape. However, after a short period of time and subsequent treatments such as prescribed fire, the evidence of treatments would fade and is not expected to affect ROS designations. As a result none of the mechanical treatments would prevent an area from meeting or moving toward ROS classifications over the long term (greater than one year).

Spring restoration and improvements would improve the resilience of these areas and make them more attractive to dispersed recreationists. The proposed improvements may cause short-term changes in the recreation settings, but would result in improvements in the setting characteristics and ROS classes over time. In both action alternatives, up to 184 springs would be improved. Mitigations to use native materials or natural-appearing materials appropriate to the ROS setting would result in natural-appearing improvements. The spring improvements would improve and meet ROS classes.

The 777 miles of channel restoration proposed would improve recreation settings over time. Mitigations to use native materials or natural-appearing materials appropriate to the ROS setting and consultation with a landscape architect regarding project design would result in natural-appearing improvements. The channel improvements would improve the settings and meet ROS classes.

Aspen treatments would take longer for recreation settings to be natural appearing in roaded natural and semi-primitive settings due to the need to fence or create barriers to ungulate grazing. Aspen groves are popular recreation settings for many users throughout the year, but especially for fall color viewing. The restoration activities would assure that aspen continue as a vital component within the ponderosa pine forest. There would be short to moderate term changes in ROS settings where aspen are treated. Aspen restoration requires that ungulates be kept out of sprouting trees until they are large enough to withstand the browsing pressure. Fencing and jackstraw piling are both proposed methods for keeping the ungulates out.

Up to 200 miles of protective barriers around springs, aspen, native willows, and big-tooth maples, as needed for restoration, would be constructed. This would cause temporary changes in the ROS class setting characteristics since the natural-appearing environment would be somewhat altered. More developed settings would appear altered for a shorter period since human alterations may be visible in these settings. Since the barriers must stay in place for many years, the primitive ROS settings would be altered for at least 20 years or until the trees can survive browsing. When the protective barriers are removed or begin to break up and decompose, treatment areas would meet ROS classes.

Alternative 3 – Focused Alternative

Recreation Sites and Uses

The effects from Alternative 3 would be the same as those described for Alternative 2 with the exception of the number of acres restored. The same design features would be applied for both Alternative 2 and Alternative 3. Alternative 3 would treat 47 percent fewer acres than Alternative 2. Approximately 39 percent fewer acres would receive mechanical and prescribed fire restoration treatments, about 26 percent fewer prescribed fire-only. Additionally, the Severe Disturbance Area Treatments would be 78 percent less in Alternative 3. Alternative 3 would have less potential to reduce the risk of large-scale, high-severity fires in the project area. It would have less of a positive effect than Alternative 2 on protecting and maintaining high quality recreation settings over time.

Developed Sites

Any vegetation treatments or prescribed burning in developed recreation sites would follow the same design features as in Alternative 2. Consequently, the effects from management activities on developed sites would protect the developed sites from any short or long-term risk of uncharacteristic wildfire similarly to Alternative 2. However, facilities at developed sites and campgrounds in the project area would be less protected from adverse short and long term effects from the risk of uncharacteristic wildfire because of the fewer area treated.

The effects explained in Alternative 2 would be the same for the following areas: dispersed recreation, trails, and recreation special use

Motor Vehicle Use

About 170 miles of temporary roads for haul access would be constructed to support restoration activities as compared to 330 miles in Alternative 2. As indicated in Alternative 2, following implementation, the temporary roads would be obliterated using techniques noted for road decommissioning. Temporary road construction would result in short-term disturbance. When possible, there would be relocation and reconstruction of existing open roads adversely affecting water quality and natural resources, or of concern to human safety. This would have long term-positive effects on water quality, natural resources, and human safety. The short-term disturbance would be less than Alternative 2 since there would be 50 percent less temporary roads built in this alternative. Additionally, there would be less increase in illegal motorized vehicle use of these roads until they are decommissioned. Once these roads have been decommissioned, they are usually not apparent to the casual user.

Recreation Opportunity Spectrum

Alternative provides for the long-term protection of recreational settings and facilities on 483,160 acres where mechanical thinning and burning would occur, by improving stand conditions and reducing fuel loading, and would lower the risk of high-severity. Maintaining healthy, green forests and reducing the risk of large-scale, high-severity fires in the project area would have a positive effect on protecting and maintaining high quality recreation settings into the future. Effects from Alternative 3 would be similar to those from Alternative 2 although on an area almost half the size.

Mechanical treatments would primarily occur in RN (50 percent) and SPM (35 percent) areas, with a lesser amount occurring in SPNM (13 percent). Mechanical treatments are expected to result in short-term effects (one to two years after treatment) where the sights and sounds of humans are more noticeable on the landscape. However, after a short period of time and subsequent treatments such as prescribed fire, the evidence of treatments would fade and would not be expected to affect ROS designations. As a result, none of the mechanical treatments would prevent an area from meeting or moving toward ROS classifications over the long term (more than one year).

Effects from Rock Pit Use and Expansion

Effects Common to All Alternatives

All alternatives would increase the level of noise, dust, and traffic in the project area. All alternatives would cause a temporary loss of access to desired recreation areas when rock pits are being used to process roadbed material and mine. There would also be potential safety issues when recreationists are using roads that are haul routes for roadbed material.

There would be no direct or indirect effects on recreation special use permittees as they could continue their normal operations as directed in their permit. Motor vehicle use should not be affected, as these rock pits would not add any access restrictions or modifications affecting recreationists.

Most rock pits are located in ROS in forested areas making them difficult to view. Under both action alternatives, design features would help mitigate the impact to recreation from rock pits.

Alternative 1- No Action

General Effects to Dispersed Recreation, Recreation Special Uses, Developed Recreation Sites, Trails and Motor Vehicle Use

If Alternative 1 were to be implemented, there would be rock mining, processing, and hauling activities at the existing and currently operational rock pits.

Alternative 1 could cause a short-term disruption of recreation uses and displacement of recreation users at and near the existing and operational pits during times when aggregate materials are being hauled. This would have the effect of concentrating operations and hauling to a relatively small number of locations, and as a result this alternative would concentrate rock mining, processing, and hauling at currently operating pits or on main hauling routes (when aggregate material is purchased from private sources and hauled onto the forests), increasing the amount of time spent in each location since fewer pits would be used.

Alternative 1 would include dust and noise impacts to nearby trails and recreation areas. Portions of the trails and recreation areas in proximity to these rock pits would likely experience increased dust, noise, and perceptions of human activity when the pits are operational. These effects would be temporary and short term.

Recreational Opportunity Spectrum

Rock pits are located in Roaded Natural, Roaded Modified, and Semi-Motorized ROS setting. The pits developed in these settings would comply with the setting characteristics. Since the pits are located away from or not in the viewshed of primary (sensitive) travel corridors, these would comply with the setting characteristics.

Effects Common to Both Action Alternatives

General Effects to Dispersed Recreation, Recreation Special Uses, Developed Recreation Sites, Trails and Motor Vehicle Use

Effects from Alternative 2 would include dust and noise effects on these resources. Portions of the trails and recreation areas that are in proximity to these trails would likely experience increased dust, noise, and perceptions of human activity. However, the maximum values of estimated noise levels for most of the heavy equipment associated with pit development would be in the 40-50 dB range for locations 0.5 miles away, or comparable to a running computer or refrigerator.

Effects from Alternative 2 would include disruption of recreation use at and near pits where roadbed materials are being mined and processed, and along haul routes that provide recreational access. Access to desired recreation resources could be altered, requiring recreationists to use another route, or go to another recreation resource where access is not disrupted by hauling activities.

There could also be safety impacts if recreationists are using the same roads as those used for hauling. Potential safety impacts to recreationists would be reduced by placing signs at major intersections on hauling routes during periods of active hauling. The effects at, and in proximity to, active pits would be temporary and short term. With the application of recreation design features, effects on trails and recreation areas would be temporary, short-term, and therefore less than significant.

Recreational Opportunity Spectrum

Most of the rock pits are located in Roaded Natural settings. One rock pit is located in the Roaded Modified and two rock pits are located in Semi-Motorized ROS setting. The pits developed in Roaded Natural, Roaded Modified, and Semi-Motorized settings would comply with the setting characteristics. Since the pits are located away from or not in the viewshed of primary (sensitive) travel corridors, these would comply with the setting characteristics.

The pits are similar to a very small mechanical treatment area, which would generally be consistent with natural vegetation patterns. For example, rock pit development would occur at the scale of non-ponderosa pine inclusions such as aspen and meadows that naturally occur in northern Arizona forests. The development would meet the intent of the management direction in the Apache-Sitgreaves Forest Plan.

Effects from Use of In-woods Processing and Storage Sites

Most processing sites are located in forested areas making them difficult to view even from 300 feet to 0.5 miles.

Alternative 1 - No Action

Alternative 1 does not propose in-woods processing sites and storage sites and would not initiate human-caused changes to the recreation resources within the project area. Alternative 1 would meet the ROS in both the Coconino and Tonto National Forests.

Alternative 2 – Modified Proposed Action

The processing sites may be used as part of 4FRI Rim Country Project implementation. Following completion of use of processing sites and removal of all equipment and materials, site rehabilitation would have to be accomplished, including but not necessarily limited to removal of aggregate, restoration of pre-disturbance site grades, de-compaction of soil for seedbed preparation, and seeding and mulching of the site with native grasses and forbs. To hasten recovery and help eliminate unauthorized motorized and non-motorized use of skid trails and temporary roads, physical measures would be used such as re-contouring, pulling slash and rocks across the line, placing cull logs perpendicular to the route, and disguising entrances.

Of the proposed 12 processing sites, nine are in Roaded Naturel ROS, 3 are in Semi-Primitive Motorized and one overlaps Semi-Primitive Motorized and Semi-Primitive Non-Motorized. Development and operation of the processing sites would not conflict with desired conditions for SPM and RN designations where there are occasional or regular sights and sounds of human influence. The processing sites could have a broader effect on ROS experience in the immediate area where operations can be heard and seen (0.14 to 2.4 miles around a site), but these would not be inconsistent with the RN, SPM, or SPNM settings. During use of a processing site, the appearance of the forest would change because most of any existing trees would be cleared on the site. The locations of the processing sites have been selected to limit the need for tree removal and would be designed so that there is visual screening from the main roads, thereby moderating the visual effects of the sites. In addition, during use there would be increased traffic and interaction between log trucks, chip vans, or other vehicles and equipment in use at the site and public use of the forest. The time of effects to ROS from the processing sites would be variable: smaller processing sites would be used over a shorter time (5 to 10 years) than the larger sites that could be in use from 10 to 20 years. After use, the areas would be completely rehabilitated and trees and vegetation would slowly be reestablished.

All of the sites are located 100 to 300 feet from forest system roads to provide for visual screening. Effects on dispersed recreational use from the processing sites includes noise disturbance from equipment and increased truck traffic entering and leaving the site. These effects would range from temporary, over a few months when the mechanical operation are active, to several years for the large sites (10 to 15 acres) that would service as focal points for in-woods processing of logs, etc.

There could be longer-term use of some processing site locations under the larger 4FRI implementation effort. Therefore, the authorization of these sites may combine with the effects from other projects occurring within or adjacent to the Rim Country project area, or in the 4FRI footprint, resulting in longer term effects from their use. Those effects would be related to noise and traffic near some processing sites.

Alternative 3 – Focused Alternative

Effects on recreation resources would be of the same type as described for Alternative 2, as all proposed in-woods processing sites could potentially be utilized.

Cumulative Effects

The cumulative effects analysis area is the Rim Country project area. The timeline for analysis is 20 years because most long-term effects of the alternatives are assessed out to a 20 year timeframe (with the exception of large-scale high-severity wildfire, which is more difficult to project).

The public experiences the cumulative effects of past management activities as the existing conditions.

Alternative 1 – No Action

Increasing population growth is also expected to drive increasing recreational demand, which would further result in decreasing recreational access and opportunity. By 2020, the Coconino National Forest is expected to experience an addition 338,000 national forest visits per year compared to current use (English and others 2014). Closures resulting from wildfires within or near the project area would combine to further reduce the available supply of recreation opportunities and access compared to demand, and would result in fewer visits to the national forests in some cases, increased crowding, and degradation of user experiences in surrounding areas that forest users travel to as a substitute recreational experience.

Alternative 2– Modified Proposed Action

Alternative 2 would restore the ponderosa pine forest health and sustainability on 889,340 acres; this combined with other restoration activities would decrease the risk of high-severity wildfire or large insect outbreaks. Increasing numbers of recreation users and demand for ponderosa pine recreation settings would continue to strain the agency's capacity and, in some areas of concentrated use, the resource capacity. With increasing demand for ponderosa pine forest settings, the large scale improvements to forest health and sustainability of this project, as well as similar vegetation and burning projects such as Upper Beaver Creek Forest Restoration, and Rim Lakes Forest Restoration, would be expected to result in cumulative retention of or improvement in the quality of recreation settings and an increase in the ability of the Apache-Sitgreaves, Coconino, and Tonto National Forests to meet recreation demands over the long term.

Past vegetation management activities resulted in an even-aged forest structure that is generally undesirable for recreation settings. It contributed to the scarcity of large, mature trees, and has not resulted in a forest with a more open structure, two setting characteristics (Ryan 2005) that have been identified as desirable to forest users. Past fire suppression activities have contributed to overstocked forest conditions, increased quantities of fuels, and decreased understory vegetation.

The current and planned vegetation management treatments and burning projects on all three forests, as well as opportunities for managed wildfire, would cumulatively result in improvements in forest health and sustainability in the ponderosa pine that are large and widespread. In the event of a wildfire or insect infestation, the restored forest would likely experience more typical low-severity fire and smaller scale insect infestation. The cumulative effects on desired recreation settings and ROS class characteristics forest users seek would be to maintain and improve them.

Alternative 2 is expected to have mostly positive effects on recreation settings due to the decommissioning of user-created routes and some existing forest roads. The quality of some recreation settings in ROS classes were declining due to unconfined motorized use. Present and future activities may result in additional degradation along camping corridors, but these would be short term and localized. There would be positive cumulative effects and an overall improvement in ROS classes because of these activities.

No new road construction is proposed now or in the future in cumulative effects projects. Motorized trails projects include new construction, road to trail conversion, and route decommissioning in appropriate ROS classes. This would have positive cumulative effects in more primitive ROS classes when decommissioned routes naturalize, and expected characteristics are re-established.

Desired recreation setting characteristics such as large, mature trees, healthy understory, and diversity of tree age classes, sizes, and species are also at high risk from the effects of climate change. While drought cycles are common in the Southwest, increasing temperatures and decreases in precipitation, in combination with overstocked forest conditions and high fuel loads are predicted to result in an increase in high-severity wildfires (Westerling 2006) (Marlon 2012)(CLIMAS. 2011). Unmanaged forests have shown increases in tree stress and mortality as a result of global warming, and old, mature trees are especially vulnerable(Ritchie and others 2008.; Van Mantgem 2009.; Williams 2010). When added to other restoration projects in the cumulative effects area alternative 2 may cumulatively result in improved forest structure, composition and diversity, more resilient forest conditions, decreased tree stress, and the potential for decreased mortality creating a more pleasant experience for visitors

Over time, effects would lessen and the crown fire risk predicted for the project area as a result of climate change would decrease. Recreation structures and environment would be made more resilient to wildfire effects by mechanical thinning and prescribed fire treatments. Since direct or indirect effects resulting from project activities would be mitigated by project design features, there would be no cumulative effects on trails, recreation sites, other structures related to recreation, and recreationists' experience.

Ongoing or planned projects of a similar nature to Rim Country within the project boundary include the Cragin Watershed Protection Project (64,430 acres), Upper Beaver (49,210 acres), Timber Mesa Vernon (41, 162 acres), Upper Rocky Arroyo (33,436acres), Larson (30,041 acres), Rim Lakes (33,770 acres) and Clint Wells (17,741 acres). These thinning and burning projects would have similar effects on recreation as Rim Country and resource impacts would be mitigated similarly. The Rim Country Project, in combination with ongoing and future projects, would not result in any detrimental cumulative effects to recreation.

Alternative 3– Focused Alternative

The focused alternative would have similar minor, short-term, and temporary negative direct and indirect effects on recreation sites and uses as Alternative 2. As noted, less area inside the project boundary would be affected by treatments. Consequently, the predicted crown fire risk because of climate change would menace more area in the project area than in Alternative 2. This would heighten the danger of disastrous consequence to recreation structures, sites, and recreation settings.

Rock Pit Use and Expansion

Alternative 1 – No Action

This analysis includes the potential cumulative effects to recreation during the 20-year implementation of this project. Numerous other projects would require the use of the same roads that are used to access recreational resources on the three national forests. Other restoration projects would still result in a cumulative increase in hauling by heavy machinery on main forest travel corridors and concentrated hauling for periods of several weeks in project areas.

The cumulative effects would be an increase in potential safety hazards such as dust and truck traffic to motorized recreation users, especially during duplicate hauling periods (which includes hauling associated with road maintenance and hauling associated with tree and slash removal). However, this cumulative effect is considered less than significant because of the long period and large area for implementation of the future foreseeable actions. If any activity from a particular project in combination with actions associated with existing rock pit activity were to affect recreational access, recreationists could find other areas on the three national forests with similar recreation opportunities.

The largest cumulative effect from this alternative would be the cumulative effect of hauling, causing traffic, noise, and dust in areas near recreation sites or on the main road system being used to access recreation opportunities. Under tis no action alternative, there would still be cumulative effects on the recreational experience for several thousand forest visitors over the next two decades.

Effects Common to Both Action Alternatives

The cumulative effects from both action alternatives (Alternatives 2 and 3) would be similar to those under Alternative 1, which include the effects of hauling, and causing traffic, noise, and dust in areas near recreation sites or on the main road system being used to access recreation opportunities. However, since more rock pits would be available for use, this would spread the effects to more areas while lessening the effects in areas where rock pits would be more intensively used without the addition of the new rock pits. The cumulative effects would be less for Alternative 3 since the treatment area is half the size of Alternative 2.

Scenery

A summary of the scenery report is presented here. The specialist report (Fargo 2019) is incorporated by reference. This analysis for the Rim Country Project is consistent with scenery-related Apache-Sitgreaves, Coconino, and Tonto Forest Plan direction, USFS policies, and applicable elements of Forest Service Scenery Management Systems.

Affected Environment

The 4FRI Rim Country Project area is important to many for its unique scenic qualities. These scenic qualities are admired from the panoramic views of the Mogollon Rim, four national trails, and the many developed recreation sites and scenic roads that wind through the project area. Due to the high concentration of visitors to the project area, the scenic resources of this area are critical to their experiences and perceptions.

The Apache-Sitgreaves, Coconino, and Tonto National Forests' natural, cultural, and historic resources provide diverse outdoor recreation opportunities that connect people with nature in a variety of settings. Forest users can hike, bike, drive motorized vehicles, camp, fish, view wildlife and scenery, and explore historic and prehistoric places. They enjoy opportunities for year-round recreation activities from birding and wild flower observing in the spring to hiking in summer months, fall color viewing and hunting, and cross country skiing in the winter. See the Recreation Report for more detail on developed recreation sites, the Recreation Opportunity Spectrum classifications, and other recreation information specific to the Rim Country project area.

In all three forests in the project area, the existing condition of scenic resources is a result of implementing the forest plans. The management of multiple resources has, to varying degrees, altered the natural landscape character. The most obvious effects on scenic resources within the project area are from vegetation and landform alterations. Resource management activities which have altered scenic resources include vegetation management, mineral extraction, utility corridors, roads and trails, development of recreation sites such as campgrounds and picnic grounds, improvements associated with special use permitted sites, livestock grazing, and fire management (suppression and prescribed burning).

The three Rim Country forests have developed a recreation niche setting to provide general context for the importance of inherent scenic qualities that contribute to the landscape character. These qualities include aesthetic, social, and biophysical features specific to Rim Country. The importance of scenic assets for recreation is described in greater detail, with supporting recreation niche maps in the scenic resource report.

Scenic Character Description

The project area is viewed at foreground, middleground, and background distances from sensitive roadways, trails, and recreation sites located inside and around the project boundary. These areas and routes, outlined in the scenic resource report, receive high use and the users have high concern for scenery. Figure 88 defines the landscape distance zones utilized in the analysis. (Forest Service 2000).

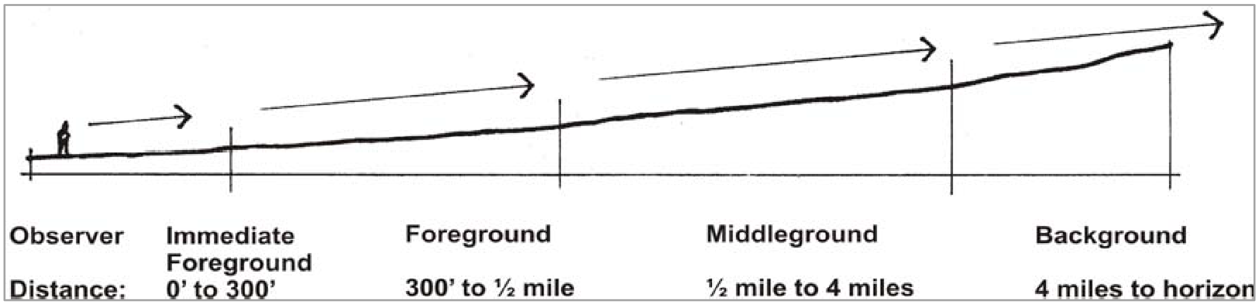

Figure 88. Landscape distance zones

The forested landscapes in the Rim Country project area are highly departed from desired conditions, lacking desired species composition, spatial arrangement, and structure, and are very dense as measured by basal area, trees per acre, and stand density index. Some of these areas are at high risk for disturbance from undesirable fire behavior, insects and disease, and climate change.

The exclusion of fire has resulted in high canopy cover and high tree density. Consequently, understory vegetation which includes aspen, oak, and other species of shrubs, grasses, and forbs is less diverse and more sparse. In the meadows and grasslands of the Rim Country project area, covering approximately 21,000 acres, conifers and junipers have encroached into these once open grassland habitats, decreasing the size and function of landscapes that were historically grasslands.

There are 728 miles of trails identified in the project area including four national trails (Figure 89). These trails offer unique recreational opportunities and an opportunity to experience the scenic quality of the project area. The following national trails are located within the project area:

- The General Crook National Recreation Trail is a 138-mile-long historic route. Portions of the trail are located on the Coconino and Apache-Sitgreaves National Forests. The trail follows the Mogollon Rim, one of the more striking geologic features in Arizona, offering spectacular views of the states central mountains and desert. Approximately 95 miles of this trail are located in the project area.
- The Arizona National Scenic Trail is a continuous, more than 800-mile diverse and scenic trail across Arizona from Mexico to Utah that crosses through the Coconino and Tonto National Forests. It links deserts, mountains, canyons, communities, and people. Approximately 70 miles of this trail are located in the project area. Approximately 30 miles of its segments overlap with other trails in the project area.
- The Blue Ridge National Recreation Trail is a 9.4-mile loop trail located on the Apache-Sitgreaves National Forests that follows Billy Creek and winds its way through ponderosa pine forest to the top of Blue Ridge Mountain. The entire trail is within the project area.
- The Highline National Recreation Trail offers beautiful vistas of rim canyons, brushy hills, distant mountains, unique rock formations, and wonderful stands of ponderosa pine. The Highline Trail runs essentially east to west below the Mogollon Rim and roughly following it. Approximately 44 miles of this trail are located in the project area.

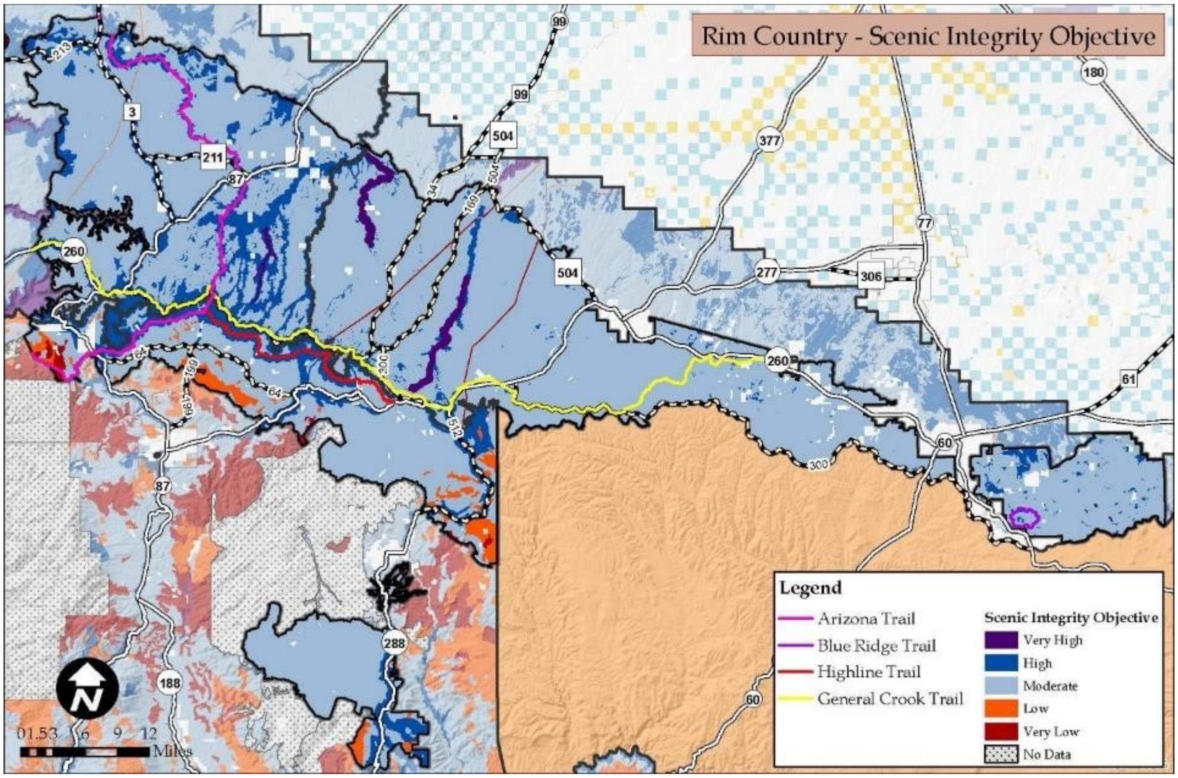

Figure 89. National trails in the Rim Country Project area

There are nine segments of eligible wild and scenic rivers on the Apache-Sitgreaves and Coconino National Forests that contribute to the scenic quality of the project area. Each system has a buffer of one-quarter mile where a High scenic integrity objective must be maintained per the forest plans. In addition, as part of its forest plan revision process, the Tonto National Forest is completing an updated eligibility report for wild and scenic rivers which would replace the existing eligibility report from 1993. To ensure compliance with current forest plan direction, this analysis includes both the eligible rivers reported in the 1993 study, as well as those listed in the current draft eligibility report. Figure 90 and Figure 91 display the locations of the eligible wild and scenic rivers on the Apache-Sitgreaves and Coconino National Forests relative to the project area, as well as the rivers from the 1993 eligibility report and the current eligibility study (ongoing) for the Tonto National Forest.

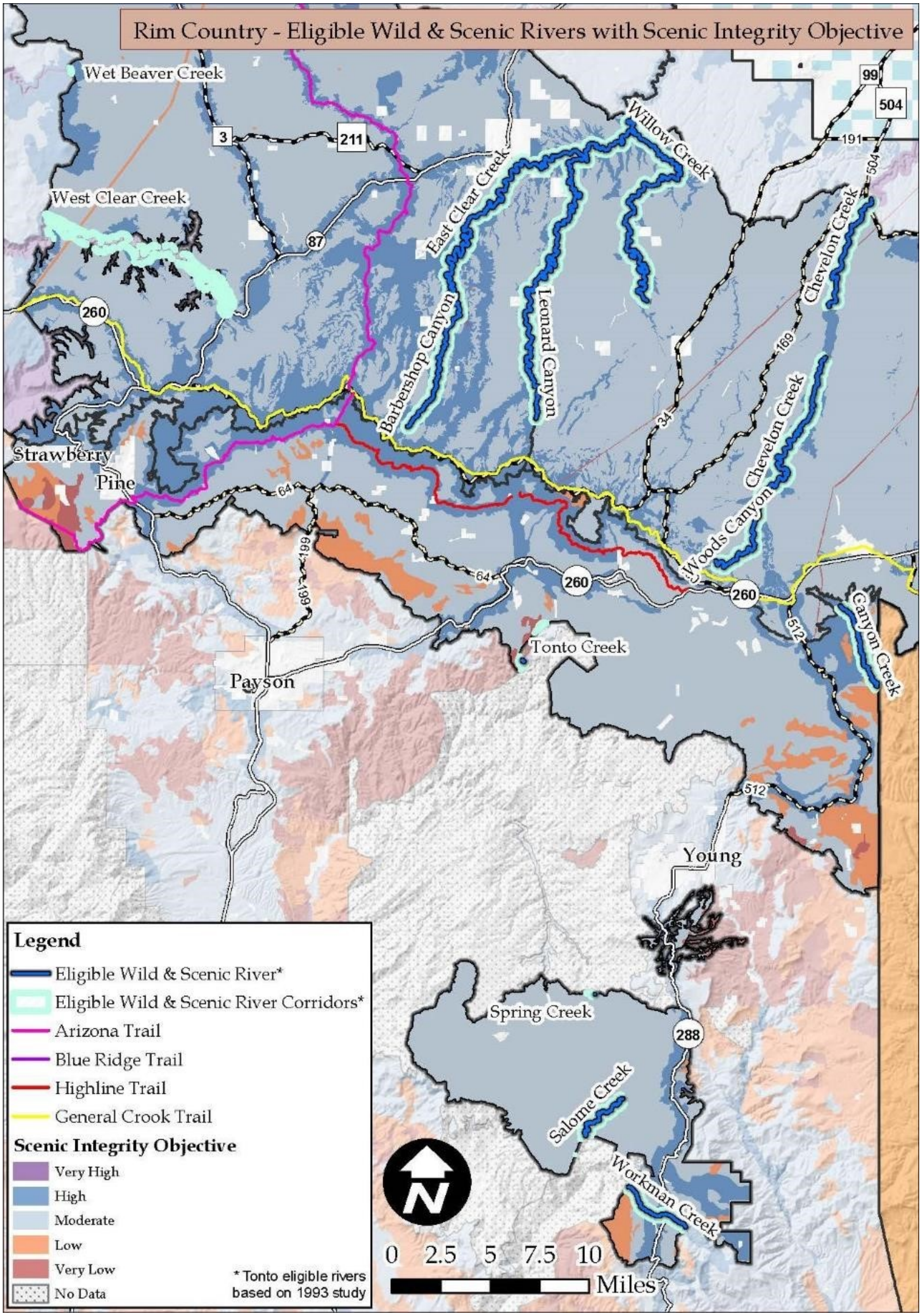

Figure 90. Eligible Wild and Scenic Rivers and Scenic Integrity Objectives (w/ 1993 Tonto National Forest)

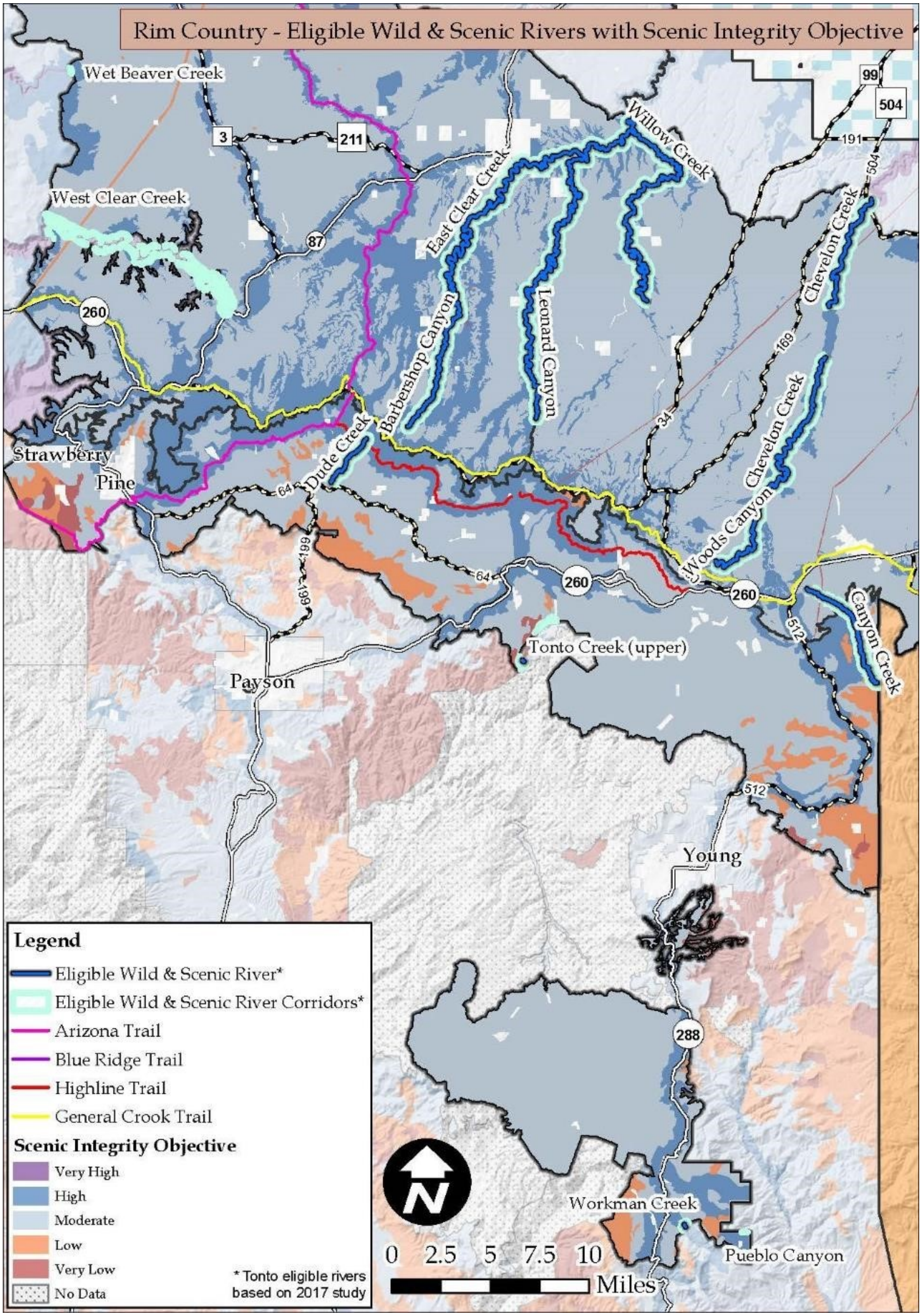

Figure 91. Eligible Wild and Scenic Rivers and Scenic Integrity Objectives (w/ Current Tonto National Forest)

Landscape visibility describes the portions of landscapes visible from travelways and use areas important to constituents for their scenic quality, aesthetic values, and landscape merits. Travelways and use areas have identified sensitivity levels for viewing scenery. Concern Level 1, the highest concern for scenery, is given to travelways or use areas that often lead to distinctive scenic features such as residential areas, resorts, and recreation areas, and attract a higher percentage of users having high concern for scenic quality, thus increasing the importance of those travelways for viewing natural-appearing scenery (Forest Service 2000). These areas most often have a High scenic integrity objective allocated to the foreground distance zone. Highway 87, Roads 3 and 512, and the From the Desert to Tall Pines Scenic Byway (288) are Concern Level 1 roads. The national trails are all examples of Concern Level 1 trails. Concern Level 2 is assigned to routes and places that are locally important, where people have a moderate to high concern for scenic quality. Forest Road 64 would be considered a Concern Level 2 route. The existing scenic integrity level ranges from Moderate to High along Concern Level 1 and 2 routes. All routes with a high scenic integrity objective adjacent to them would be considered Concern Level 1 routes.

Ecosystem Context

The vegetation is the dominant scenic attribute in the Rim Country project area. There are substantial opportunities for improvement of the ecological function and for scenery attributes. The existing vegetation density and lack of high frequency, low-severity fires are inconsistent with the desired scenic character and its sustainability.

- Currently, the dense conifer vegetation often obscures views of existing scenic attributes within the forest canopy and understory, and greatly restricts viewing access to potential scenic attributes. Among the potential attributes are large mature trees; diverse species including aspen, evergreen oak, Gambel oak, and grasslands; as well as other understory shrubs, grasses, and forbs.
- Inter-tree spaces (interspaces) and openings have been filled with small and medium sized trees, where if these were opened up, sunlight would reach the forest floor, adding to the scenic quality as well as helping provide for greater understory vegetation composition and abundance.
- Fire has been suppressed for many years and this, in combination with overly dense forests, departs significantly from reference conditions. Currently there is a risk of large-scale, high-severity fire that could result in elimination of the vegetation scenic attributes that are desired. High frequency, low-severity fire helps to recycle nutrients, keep tree densities lower, and keep fuel accumulations lower.
- Seeps, springs, and ephemeral drainages have had conifers encroach and overtop other species, reducing their function over time. When these features are functioning properly, they provide high scenic quality and auditory, tactile, and visual features not found without the presence of water.
- Throughout the forests, unauthorized routes and redundant roads have been created. These detract from the scenic quality of the area by forming unnatural linear features that are uncharacteristic of the landscape. Decommissioning these roads would restore characteristic forest landscape features.

Assumptions and Methodology

Assumptions

- Scenery Management System terminology will be used in the tables, maps, and environmental consequences section of this report to more uniformly describe effects.

- Treatment location, in relation to terrain and elevation and other vegetative screening, can affect the visibility of management activities. Vegetation treatments on steep slopes, when other landforms do not block the view, can dominate the landscape.
- The duration of view or speed of travel through an area (such as, walking or riding in a vehicle) determine how long a viewer has to study and pick out objects, forms, lines, colors, and patterns in the landscape.
- How well treatments transition from treated to untreated areas can also affect how evident a treatment is in all distance zones.
- Proposed activities, although they may have some short-term negative effects on scenery, also may begin to move the landscape toward the desired landscape character. Effects that would move the vegetation toward the desired landscape character are beneficial to scenic resources in the long term. These beneficial effects are often realized over a long period of time but lead to the lasting sustainability of valued scenery attributes. For example, tree thinning may have short-term effects of ground disturbance, stumps, and slash, but in the long term, if properly mitigated for scenery, may provide visual access into the forest and promote large tree growth and a smooth herbaceous ground cover. In the long-term, the removal of some trees, dependent upon scale and intensity of treatment, may be a beneficial effect for scenery.
- Desired landscape character often includes and is linked to preferred visual settings. Gobster (1994) summarizes visually-preferred settings as having four common attributes: large trees, smooth herbaceous ground cover, an open midstory canopy with high visual penetration, and vistas with distant views and high topographic relief.
- Visual access, or how far one can see into a forest, is also a preferred scenic setting (Ryan 2005). The degree of visual access varies throughout the project area, depending on the amount of understory vegetation present in the forest. Younger ponderosa pine forests may have dense vegetation, which allows very little visual access into the forest. In the long term, scenic resources would have higher scenic quality if visual access is achieved or enhanced.

Methodology

This analysis applies current National Forest Scenery Management methodology in conjunction with existing Apache-Sitgreaves, Coconino, and Tonto National Forest Plan direction. ArcMap and GIS data layers were used to analyze the proposed activities in regards to recreation use, sensitive travel corridor locations, areas potentially seen from sensitive travel corridors and use areas, and visual quality objectives and scenic integrity objectives assigned to the area. The potential effects on scenic resources from this project were determined based on a site visit to the project area with members of the interdisciplinary team, review of photos of the project area, use and interpretation of GIS data and aerial imagery, and review of research and analysis of similar projects including the 1st 4FRI project analysis and scenic resource report. Direct, indirect, and cumulative effects were considered in this analysis.

Scenery Management System (SMS)

The Scenery Management System places importance on identifying which scenic elements forest constituency most values, and developing management strategies to maintain or improve those elements. The Apache-Sitgreaves and Coconino Forest Plans currently use SMS. The Tonto National Forest will be transitioning from VMS to SMS at a later date. For consistency in this analysis, the SMS terminology will be used in tables, maps, and the environmental consequences section.

The Scenic Integrity Objectives (SIOs) are used in the Scenery Management System and are described in more detail in the scenic resources report. They range from Very High, meaning the landscape character is unaltered, to Very Low, meaning the landscape character is highly altered. Intermediate levels include High (landscape character appears unaltered), Moderate (landscape character is slightly altered), and Low (landscape character is moderately altered). Scenic integrity objectives can be applied in two ways: (1) to describe a degree of existing scenic integrity or disturbance, or (2) to describe a minimum objective for future integrity.

Figure 92 displays the scenic integrity objectives for the project area (the visual quality objectives for the Tonto National Forest have been converted to SIO). For the 4FRI Rim Country Project, these scenic integrity objectives represent the long term goals for the restoration activities proposed. The majority of the project area is mapped as Moderate where the landscape character “appears slightly altered.” The areas designated as High or Very High are generally located along sensitive scenic areas such as scenic roadways or highly traveled routes, or along eligible Wild and Scenic Rivers. There is also a small amount of Low on the Tonto National Forest.

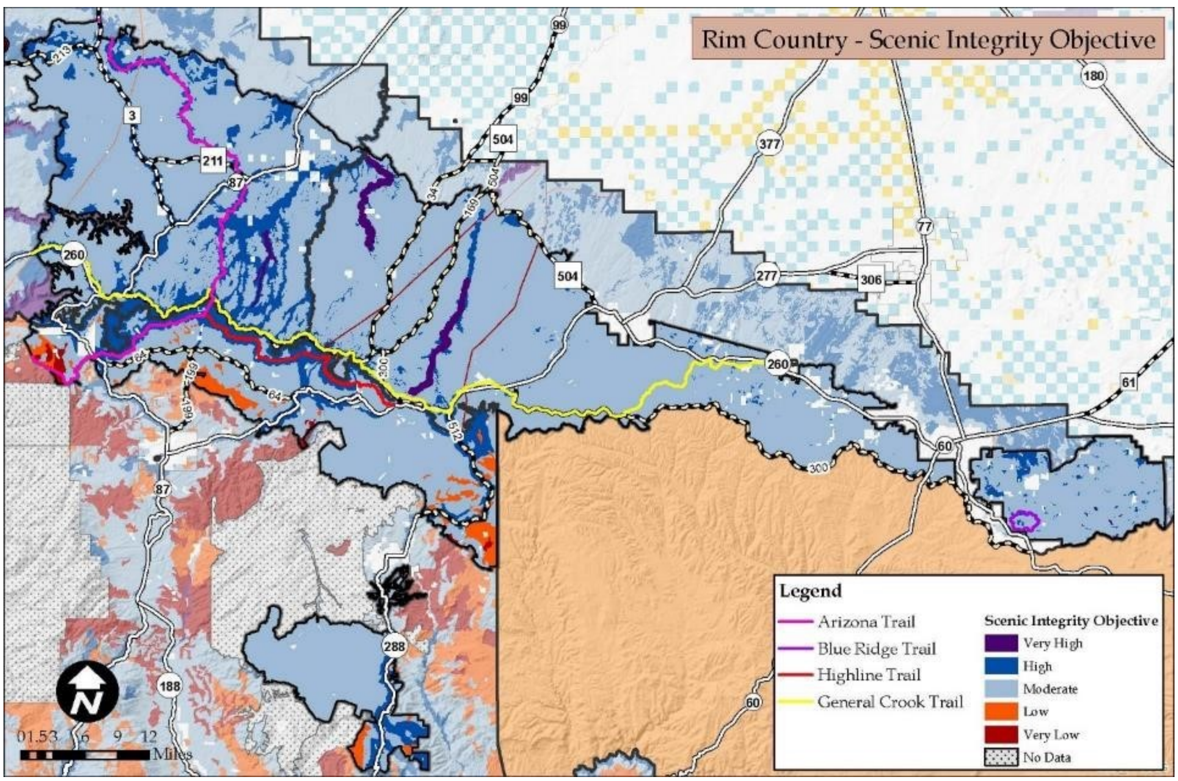

Figure 92. Scenic Integrity Objectives for the entire project area

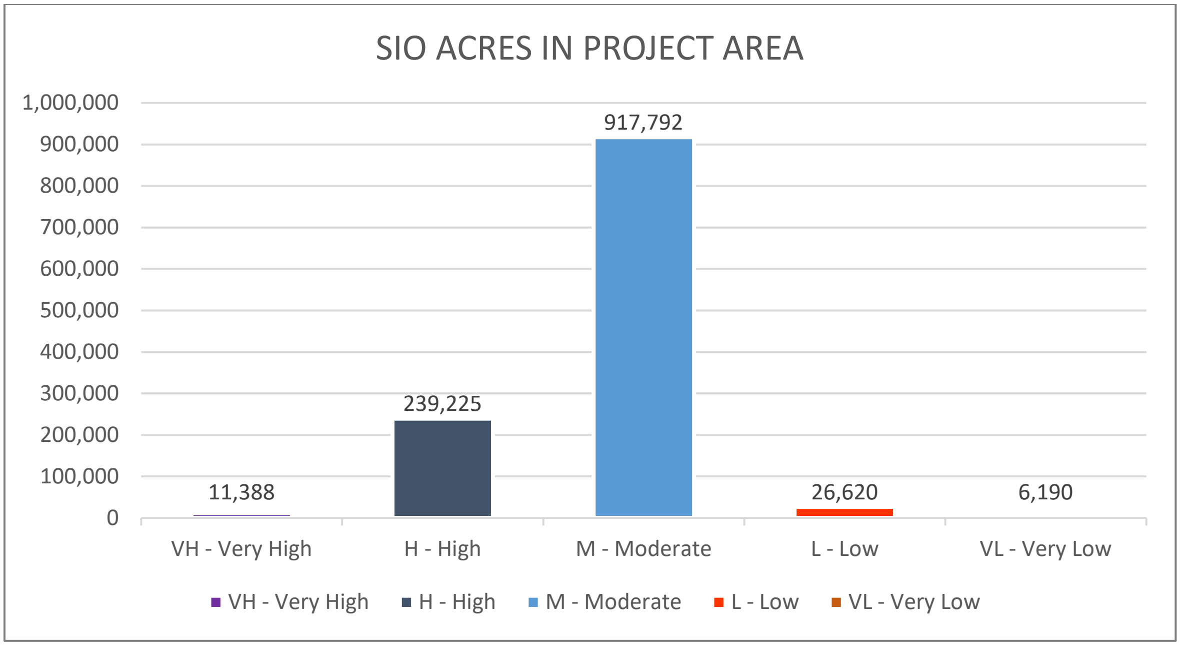

Figure 93. Acres of Scenic Integrity Objective

Spatial and Temporal Context for Effects Analysis

The spatial boundaries for analyzing the direct and indirect effects on scenery are National Forest System lands within the project area boundary since the proposed activities would only occur on National Forest System lands.

Short-term scenic effects from vegetation management are often the most noticeable until the growth of grasses, shrubs, and remaining trees begin to soften the effects of thinning operations. Short-term for this analysis refers to a three to five-year period after all vegetation treatments in an area are complete. Short-term effects are especially noticeable when the viewer has an up-close view of the treatment site, usually in the foreground viewing distance.

Long-term effects, which for this analysis is considered beyond five years, vary by the treatment and the method used.

Past harvest of forested slopes is generally noticeable for 15 to 30 years, depending upon the treatment prescription, soil type, aspect, and vegetative species composition. At the end of this time period, the regrowth of vegetation begins to develop closed canopy characteristics and the area no longer appears altered. The cumulative effects analysis area consists of all lands, including other ownerships inside the 4FRI Rim Country project boundary.

Environmental Consequences

Alternative 1 – No Action

Alternative 1 proposes no additional management activities in the project area and initiates no human caused changes to the scenic resources or visual quality objectives within the project area. In the short term, the scenic integrity would remain unchanged and the project area would continue to be mostly natural-appearing for several years. In the long term, important scenic attributes such as scattered groups of trees of all ages with grassy openings, evidence of frequent low-severity fire, large mature tree character, diverse understory, prominent Gambel oak and grasslands, functioning riparian systems and ephemeral channels that historically contributed to the attractiveness of the area would continue to decline along with scenic integrity.

There is the potential, if dense stands foster beetle outbreaks, more severe mistletoe infections, or other forest health concerns, that tree vitality would decline and there would be a reduction of scenic integrity. If stand-replacing wildfire were to occur, this would also result in the loss of valued scenic character and would continue to be of concern to the Coconino, Apache-Sitgreaves, and Tonto National Forests and residents of the surrounding communities. If a large fire or series of fires occur, views of a fire-altered landscape may begin to dominate. Effects on scenic quality include charred bark on standing trees and down logs, a blackened appearance to the ground plane, and burned understory plants. The visual effects would be reduced within two years, with the regeneration of ground cover plants and the deposition of forest litter over the burned sites. Charred bark, limbs, and other features may be visible for many years. The burned areas would likely regenerate in dense stands of shrubs and seedlings, particularly in moist sites at the bottom of drainages and where root stock and seed sources exist.

These changes would be visible throughout the project area in the foreground of forest roads and trails, and as middle ground and background views from communities within the project area, and developed recreation sites. If a wildfire were to occur near a recreation site, those who use the sites may choose to go elsewhere, if they are sensitive to the appearance of a fire-altered landscape.

Under this alternative there would be no opportunities to enhance and improve scenic resources or achieve the desired conditions, since there would be no thinning, prescribed fire, or other treatments related to restoration. The forests would continue to implement small-scale thinning and prescribed burning, but nothing on the scale of this project. As a result, very little progress would be made toward desired conditions.

The No Action Alternative would not meet forest plan desired conditions or forest plan direction. It would not meet long-term scenic integrity objectives since these are dependent upon improving the condition of scenic attributes so that they are more resilient to ecological stressors. In addition, the No Action Alternative would continue the current condition outside of the natural range of variability.

The comparison of effects from the No Action alternative indicates that the only positive effect or trend would be the cumulative effect of Motorized Travel Management. All other ongoing or reasonably foreseen actions would result in a decline in the vegetation, water, and land form that create the landscape character of the area; decreased long-term scenic attractiveness as the unique natural and cultural elements that combine to form the scenic beauty of the area decline; and a downward trend in the scenic integrity objectives as deviations from the valued landscape character become more pronounced.

Effects Common to Both Action Alternatives

The effects on scenery from Alternative 2 would be the same as those from Alternative 3 with the exception of the difference in treatment acres where the effects would occur. Alternative 3 would treat 47 percent less area than Alternative 2, so the following effects can be expected to affect scenic resources in less of the project area with Alternative 3.

Aspen, Native Willows, Big-Tooth Maple, Seep/Spring Protective Barriers

Aspen, native willows, big-tooth maple, ephemeral drainage treatments and spring/seep areas require protective barriers to protect the areas from browsing. Both action alternatives require up to 200 miles of protective barriers. Barrier materials proposed include wire, wood and jackstrawing of trees. All would introduce unnatural linear features into the landscape that would not be natural appearing. Since these are isolated areas scattered around the over 1,000,000 acre project area, introduction of linear features would have minor effects.

Wood fencing materials would have the least effect since they would be in scale, and have texture and color that would look most natural in the seep/spring and aspen settings. Many times wooden fencing is viewed as an attractive cultural feature. If the fences are maintained, wood fencing would have very low effects and would meet the SIO. If they fall into disrepair, this would detract from their appearance, but they would still meet the SIO.

Wire fencing materials would be more noticeable than wooden fences. Wire and metal posts can be shiny and their color can contrast with the natural surroundings. Design features would be used to introduce the fewest contrasting elements where wire fencing is used and effort would be made to locate the fencing where it is least noticeable. Wire fencing would have low effects and would meet the SIO.

Jackstrawing has been used to a limited extent on the Coconino National Forest in order to protect aspen restoration projects from ungulate browsing. It involves cutting and stacking high numbers of cut trees in an irregular manner to form a wide, tall barrier surrounding the aspen stand. While natural materials would be used to create the jackstraw, the shape and form created at this scale would not normally be found in the characteristic landscape. It would not be completely unnatural however, as it would be similar to large scale blow down events that may be caused by weather related events. Placement of jackstraw treatment would not meet the requirements for foregrounds of Concern Level 1 roads or the National Trails in high SIO areas. Even if foreground sites were allowed to drop one SIO level, they would still not meet the basic definition of moderate SIO that "noticeable deviations must remain visually subordinate to the landscape character being viewed" (Forest Service 2000). Beyond the foreground, jack-straw piling may be suitable, and would be mitigated by carefully locating these barriers. As noted, the short term effects timeline for jackstrawing around aspen would be longer than for conifers, up to 20 years. Design criteria would be implemented to avoid placement of jackstraw within the foreground of high concern level roads or National Trails. As jack-straw barrier begins to deteriorate, trees lose their brown needles, branches break off, and logs lose their bark and grey out, the jack-straw piles compress and become less noticeable. It is anticipated that the aspen would also be large enough to withstand ungulate browsing when the jack-stray piles deteriorate or are burned in follow up prescribed burning activities. These areas would improve over time to the mapped SIO.

Landings and In-woods Processing and Storage Sites

Landing sites, where logs are processed for removal, are a primary short term visual effect. These sites are cleared, and scraped and leveled. Slash, log decks, and equipment dominate the immediate foreground view, and may be evident from a foreground view. Ground disturbance occurs from trucks, loaders and skidders moving over the site. After harvest is complete and slash has been removed, the site disturbance may be evident for approximately five years following use of the site. Sometimes landing sites require additional tree clearing.

Trails

People are often more sensitive to changes in the landscape along trails, than along roads and recreation developments. This is because they travel at a slower pace, and are immersed in the environment, and tend to have an expectation for a natural appearing setting. Smaller details, such as stumps and slash, are more likely to be noticed.

As a result, a decrease in the sense of solitude and diminished scenic quality would likely occur while traveling the trails within the project area. Most viewers may perceive diminished scenic quality along area trails until slash is reduced, and the remaining trees have matured. Temporary roads and skid trails may potentially cross the trails. There may be a reduction in the natural appearance of the forest as viewed from the trail. There may be increased encounters with people and machinery until the project is completed. Many of the trails provide access to unmanaged areas; this negatively affects visitor's experience when they anticipated a more natural, unmanaged environment. This would be reduced over time, and should be a minimal effect over 10 to 15 years, once ground cover and understory are reestablished and the slash has been reduced.

The Scenic Integrity would likely be reduced in the foreground and middleground, because viewers would more likely be aware of details as treatments. A decrease in the sense of solitude could lead to displacement of trail users in the short term (1 to 5 years.) They may opt to visit other areas where they would have the experience of a landscape that appears unmanaged.

National Trails, specifically the Arizona, Highline and General Crook Trail would have similar short term effects on scenery as described above. However, additional design criteria specific to National Trails would help protect the scenic integrity, especially in the foreground of the trail, during project implementation. Ultimately, in the long term, the vegetation activities would move the vegetation adjacent to trails towards desired conditions outlined in the Forest Plan.

Developed Recreation Sites

Mechanical and prescribed fire treatments could negatively affect developed recreation sites. However, developed recreation sites would not be modified by any alternatives as design features have been developed to protect the sites from possible negative effects from proposed treatments in Alternatives 2 and 3.

For campsites, it is desirable to provide and retain privacy and screening, screen other constructed features such as restrooms, provide shade, retain unique character trees and so on. Per the design criteria for recreation campgrounds, these areas would be treated, but require coordination with the District Recreation Staff in order to determine places where no treatment would occur in order to protect constructed features. In addition prioritizing treatments, treatment timing and slash pile locations would be agreed upon. Immediate adjacent to the campgrounds (outside of fenced or otherwise delineated campground boundaries), prescribed burning or mechanical treatments and burning would be appropriate.

For other developed recreation sites, it is appropriate to include burning or mechanical treatments and burning outside of an established boundary that would protect the constructed features at these sites. Per the mitigations for recreation, these boundaries would be established in conjunction with the District Recreation Staff prior to treatment.

Effects of treatments in developed recreation sites would be similar to those analyzed for mechanical treatments and prescribed burning discussed in this report under Alternatives 2 and 3. There would be short term reductions in scenic quality as a result of treatments. In the long term, the treatments would help to reduce risks to scenic stability and would improve the overall scenic integrity.

Eligible Wild and Scenic Rivers

The overall objectives for management within the project area are to bring the landscape closer to the desired conditions outlined in the Forest Plan. Wild and scenic rivers are managed to protect the outstandingly remarkable values for which they were designated in the National Wild and Scenic River

Preservation System and to protect their free-flowing nature. Rivers determined to be eligible for the System are also managed to protect the outstandingly remarkable values for which they are eligible. There are currently 9 eligible wild and scenic rivers on the Apache-Sitgreaves and Coconino National Forest and additional segments on the Tonto National Forest from the 1993 eligibility study and the current eligibility study. A map illustrating the locations of the segments are in the Scenic Character Description in the scenery report. The tables below show the classifications of each eligible wild and scenic river segment (including the Tonto 1993 and current eligibility study) as well as the treatment type and acres affected for each alternative.

Table 99. Eligible Wild and Scenic Rivers on the Apache-Sitgreaves and Coconino National Forests for Alternative 2

River Name and Class	Mechanical & Prescribed Fire	Prescribed Fire Only	Total Acres
Barbershop Canyon	**2,601**	**1,140**	**3,741**
Wild	2,601	1,140	3,741
Chevelon Creek	**2,228**	**5,053**	**7,281**
Recreational	617	0	617
Scenic	1,611	0	1,611
Wild	0	5,053	5,053
East Clear Creek	**3,406**	**2,063**	**5,469**
Scenic	3,406	2,063	5,469
Leonard Canyon	**3,542**	**2,372**	**5,914**
Recreational	3,542	2,372	5,914
West Clear Creek	**1,194**	**551**	**1,745**
Wild	1,194	551	1,745
Wet Beaver Creek	**8**	**11**	**19**
Wild	8	11	19
Willow Creek	**0**	**4,806**	**4,806**
Wild	0	4,806	4,806
Grand Total	**12,979**	**15,996**	**28,976**

Table 100. Eligible Wild and Scenic Rivers on the Tonto National Forest for Alternative 2 Identified in the 1993 Eligibility Study

River Name and Class	Mechanical & Prescribed Fire	Prescribed Fire Only	Total Acres
Canyon Creek	**1,150**	**364**	**1,514**
Recreational	1,150	364	1,514
Salome Creek	**1,112**	**0**	**1,112**
Wild	1,112	0	1,112
Spring Creek	**34**	**0**	**34**
Recreational	34	0	34
Tonto Creek	**150**	**0**	**150**
Wild	150	0	150
Workman Creek	**1,159**	**0**	**1,159**
Recreational	1,159	0	1,159
Grand Total	**3,605**	**364**	**3,969**

Table 101. Eligible Wild and Scenic Rivers on the Tonto National Forest for Alternative 2 Identified in the Current Study

River Name and Class	Mechanical & Prescribed Fire	Prescribed Fire Only	Total Acres
Canyon Creek	**1,548**	**364**	**1,913**
Recreational	1,548	364	1,913
Dude Creek	**1,045**	**0**	**1,045**
Recreational	1,045	0	1,045
Pueblo Canyon	**0**	**9**	**9**
Wild	0	9	9
Tonto Creek (upper)	**211**	**0**	**211**
Scenic	211	0	211
Workman Creek	**82**	**0**	**82**
Recreational	82	0	82
Grand Total	**2,886**	**373**	**3,259**

Table 102. Eligible Wild and Scenic Rivers on the Apache-Sitgreaves and Coconino National Forest for Alternative 3

River Name and Class	Mechanical & Prescribed Fire	Prescribed Fire Only	Grand Total
Barbershop Canyon	**2,601**	**1,054**	**3,656**
Wild	2,601	1,054	3,656
Chevelon Creek	**235**	**3,441**	**3,676**
Recreational	66	0	66
Scenic	169	0	169
Wild	0	3,441	3,441
East Clear Creek	**2,581**	**1,718**	**4,299**
Scenic	2,581	1,718	4,299
Leonard Canyon	**3,542**	**2,372**	**5,914**
Recreational	3,542	2,372	5,914
West Clear Creek	**877**	**111**	**988**
Wild	877	111	988
Wet Beaver Creek	**8**	**0**	**8**
Wild	8	0	8
Willow Creek	**0**	**3,504**	**3,504**
Wild	0	3,504	3,504
Grand Total	**9,844**	**12,200**	**22,044**

Table 103. Eligible Wild and Scenic Rivers on the Tonto National Forest for Alternative 3 Identified in the 1993 Eligibility Study

River Name and Class	Mechanical & Prescribed Fire	Prescribed Fire Only	Grand Total
Canyon Creek	1,150	364	1,514
Recreational	1,150	364	1,514
Salome Creek	707	0	707
Wild	707	0	707
Spring Creek	0	0	0
Recreational	0	0	0
Tonto Creek	57	0	57
Wild	57	0	57
Workman Creek	820	0	820
Recreational	820	0	820
Grand Total	2,735	364	3,099

Table 104. Eligible Wild and Scenic Rivers on the Tonto National Forest for Alternative 3 Identified in the Current Study

River Name and Class	Mechanical & Prescribed Fire	Prescribed Fire Only	Grand Total
Canyon Creek	**1,548**	**364**	**1,913**
Recreational	1,548	364	1,913
Dude Creek	**1,045**	**0**	**1,045**
Recreational	1,045	0	1,045
Pueblo Canyon	**0**	**0**	**0**
Wild	0	0	0
Tonto Creek (upper)	**117**	**0**	**117**
Scenic	117	0	117
Workman Creek	**7**	**0**	**7**
Recreational	7	0	7
Grand Total	**2,717**	**364**	**3,081**

As noted in the Interagency Wild & Scenic Rivers Coordinating Council Technical Paper (IWSR Coordinating Council 2014) "Timber management activities on federal lands within WSR corridors must be designed to help achieve land-management objectives consistent with the protection and enhancement of the values that caused the river to be added to the National System. Management direction needed to protect and enhance the rivers values is developed through the river planning process. WSR designation is not likely to significantly affect timber management activities beyond existing measures to protect riparian zones, wetlands, and other resource values as guided by other federal requirements." In addition, "Timber management activities on federal lands outside the corridor are managed to protect and enhance the values that caused the river to be designated. Measures needed to protect and enhance the rivers values are developed through the river planning process and include management direction as necessary for lands adjacent to the corridor."

The treatment areas that overlap the proposed WSR boundary have specific design criteria for scenery, recreation and other resource protection. The design features have been included in Appendix C specifically for the purpose of adjusting proposed treatments in the future as eligibility and suitability are determined. Any management activities proposed in eligible wild and scenic river corridors in the Rim Country project area would have the purposes of restoring natural geomorphic and ecological processes and the specific outstandingly remarkable values (ORVs) of the river. These activities are proposed to move the vegetation within the corridor towards desired conditions outlined in the Forest Plan and according to the standards and guidelines for the river corridors. In addition, the proposed activities would help to protect potential scenic values of the eligible wild and scenic river from the effects of wild fire. For both Alternatives, there would be short term effects associated with mechanical treatment and prescribed fire within the eligible wild and scenic river corridors, but in the long term, the proposed vegetation treatments would increase diversity for scenery. Overall, the scenery outstandingly remarkable value would be maintained and enhanced.

Wilderness

There are no treatments proposed in wilderness therefore there would be no effects on wilderness areas. However, at the viewpoint toward or from the Wilderness, there would be a change in the texture between the forested area that would be treated outside the Wilderness, and the untreated forest within the wilderness. There would be increased areas of ground seen between the remaining trees, giving a more coarse appearance to the landscape and slopes. In the case where the Wilderness boundary crosses on a slope, it is possible that this boundary may be evident to observers because of the change in the forest texture. Because of the increased dominance, the scenic integrity may likely be reduced in the short term.

Large Mature Trees

The proposed actions would meet forest plan requirements for large mature trees across the landscape. Some allocated acres may not meet all old growth characteristics, but would move conditions toward requirements for large trees, downed woody debris, and snags. The more open, groupy character of the conifer forest would help make the trees more visible and as a result, more prominent. Use of the old tree strategy would help recruit and retain large trees. The treated areas would have more of the desired landscape characteristics and would make progress toward meeting SIO.

Proposed Activities for Mexican Spotted Owls

As a result of the treatments proposed under this alternative, stands throughout most of the project area would appear more to have the desired conditions of open, groups of trees of all ages and sizes. In some areas, treatments are modified for Mexican spotted owls. These changes are designed to meet other laws, regulations and policies.

MSO treatments proposed incorporate the need for "Improving habitat structure in addition to managing for fire risk abatement is consistent with the USFWS draft MSO recovery plan that focuses on desired conditions and provides for treating PACs to meet restoration and fuels reduction objectives. A key draft recovery objective is to maintain habitat conditions necessary to provide roosting and nesting habitat (pp. 84-85) (USDI 2012)". This treatment would result in stands appearing slightly more open and more diverse over time when compared to the existing condition, although the difference may not be noticeable to the casual forest visitor, particularly when driving along the roads. The treatments proposed for MSO would move the habitat toward desired conditions, but scenic attributes in these areas would continue to be at risk from ecological stressors.

Alternative 2 – Modified Proposed Action

Mechanical Treatment and Burning

Approximately 889,340 acres would be mechanically thinned or burned under this alternative. Mechanical treatments include but are not limited to the use of chainsaws or feller-bunchers to cut trees and lop slash, skidders to move material to landings, bulldozers to pile slash, and specialized equipment such as feller-bunchers or track-type hot saws, and tree shears to cut, chop, break, and lop fuel material.

Hand thinning usually has little or no short-term effects on scenery. Trees are cut down, then cut into segments that can be treated. Effects may include slash from limbing and topping trees. Project mitigations require slash to be treated.

Conventional mechanical treatments typically have moderate short-term effects on scenery. During implementation, in most cases whole trees are cut and moved to a "landing" near a haul road. At the landing, the limbs and tops are removed, and the clean logs are decked to be loaded and hauled away. After vegetation has been thinned, the slash is piled using bulldozers. Effects typically include trampling of vegetation where equipment is operating, creation of linear skid trails where vegetation is trampled or completely removed exposing bare soil, creation of linear log landings where vegetation has been removed and bare soil is exposed, and piles of cull logs not suitable for commercial uses. After logs or useable material is removed, slash would be treated as per mitigation measures. This may include bulldozers push slash into large piles (10to 20 foot wide piles, often 10 feet tall) which can trample vegetation and cause bare soil to be exposed, and hand piling. Design criteria would prioritize treatment of slash along high concern level roads (those in High SIO), require trails to be returned to pre-treatment conditions, and cull logs be removed from landings and potentially used to help close off entrances to decommissioned roads.

There would be a low to moderate effect on scenic quality during and immediately following mechanical treatments. Stumps are typically left no more than six inches high and are often cut flush with the ground unless prevented by rocks or other natural features. The presence of skid trails, landings, and piled or scattered slash would also result in a moderate reduction of the scenic quality until harvesting activities are completed and design features are implemented. The effects in these areas would be short term (lasting one to five years after treatment) since skid trails would be rehabilitated and activity-generated slash would be treated or mostly removed to be utilized. The ground disturbance resulting from using machines to pile slash would be noticeable for one to three years after project completion, depending on how quickly the areas revegetate. Scraped trees would heal or scars would become less noticeable over time.

Prescribed burning would likely result in short-term, moderate reduction in scenic quality, but with ground vegetation recovery, can enhance scenic beauty within five years. Where prescribed fire is limited to slash reduction, isolated areas of burned piles would be evident. Once these piles have been scattered there may be some short-term evidence of darkened litter and soil that would be reduced within five years and generally only be noticeable within the immediate foreground. Greater visual effects would occur in areas where prescribed fire is used as a tool to regenerate aspen or reintroduce fire. This includes charred bark of standing trees and down logs, and a blackened appearance to the ground plane and burned understory plants. The visual effects would be reduced within two years, with the regeneration of ground cover plants and the deposition of forest litter over the burned sites. Charred bark, limbs, and other features could be visible for many years.

Smoke from prescribed burning would be heaviest during the initial burns, and would reduce visibility of the scenic landscape in the short term. Some residual smoke could be expected to continue in small localized areas where stumps or roots smolder for up to a few weeks. The residual smoke would have little if any effect on visibility of scenic attributes.

The restoration treatment areas should be recovered and moving toward reference conditions after the first thinning and prescribed burning activities. These would be further improved after follow-up prescribed fire treatments. The restoration treatments would meet the purpose and need of the project and would help move the forest structure, pattern and composition toward reference conditions.

Road Reconstruction and Decommissioning

Approximately 150 miles of existing roads would be reconstructed with Alternative 2. There would be few to no effects from road improvements. Improvements may include, but are not limited to, drainage improvements, tree removal, slight realignments, and addition of surfacing materials. Potential effects include exposure of bare soil, tree stumps, and contrasting color and texture of surfacing materials. These effects are usually short term (one to five years) and become less noticeable as natural vegetation is re-established and the surfacing material begins to be incorporated into the soil horizon. Road relocation would have more noticeable effects on scenery. Effects of the newly constructed road bed would include newly exposed bare ground, damaged vegetation, tree stumps, root wads, and contrasting color and texture of surfacing. There would also be effects associated with the old road bed. It would appear newly disturbed as well if associated drainage features such as culverts are pulled, new drainage ditches established, the surface roughened to promote vegetation establishment, and slash, brush, boulders or other devices are used to close off the entrance. There would be a strong contrast between the existing forest floor and the new and old road beds that would detract from scenic quality. Design features, best management practices, and mitigation measures would be used during road reconstruction. The old roads would naturalize over time and become less noticeable to the casual observer.

Approximately 330 miles of temporary roads would be constructed for haul access. These would be decommissioned when treatments are finished. The new temporary roads would add new, unnatural linear features to the landscape on a temporary basis. Trees would be removed, soil exposed, and roadbeds constructed including minimal drainage features. This would have moderate effects on the mapped scenic integrity objectives. In High scenic integrity objective, the new temporary road construction would drop these areas one level to Moderate until the roads are decommissioned and begin to naturalize, about five years later. Design features and best management practices would be used to rehabilitate decommissioned roads and this would hasten their recovery.

Under this alternative up to 200 miles of system road on the Coconino and Apache-Sitgreaves National Forests could be decommissioned. The Tonto National Forest Travel Management EIS has identified approximately 290 miles of road within the Rim Country project area for decommissioning. In addition to system road decommissioning, up to 800 miles of unauthorized roads on all three forests could be decommissioned under this alternative. Following decommissioning, all roads would be allowed to naturalize. There would be short-term effects (up to five years) as the roads have drainage established, the surface area roughens, is seeded and mulched with pine needles and slash, and boulders and other devices are used to close off entrances to the roads. Design criteria and best management practices would be used to rehabilitate these roads. The existing closed roads would naturalize over time and become unnoticeable to the casual observer.

Alternative 3 – Focused Alternative

Mechanical Treatment and Burning

Alternative 3 treats 47 percent less area than Alternative 2. Approximately 39 percent fewer acres would receive mechanical and prescribed fire restoration treatments, about 26 percent less prescribed fire only. Additionally, the Severe Disturbance Area Treatment area is 78 percent less in Alternative 3 than in Alternative 2. Approximately 483,160 acres would be mechanically thinned or burned with prescribed fire under Alternative 3. For Alternative 3, there would be less prescribed burning activity that would likely result in less short-term, moderate reductions in scenic quality relative to Alternative 2. As a result, there would be fewer visual effects in the project area where prescribed fire is used as a tool to regenerate aspen or reintroduce fire, resulting in fewer areas of reduced visibility of the scenic landscape in the short term. However, Alternative 3 would treat significantly fewer acres of grasslands, savannah, and open canopy cover, resulting in fewer acres of improved understory species abundance and composition. Ultimately, this alternative would have less potential to reduce the risk of large-scale, high-severity fires in the project area. Since high-severity fire is a risk factor for most scenery attributes, the fewer proposed mechanical and prescribed fire treatments in Alternative 3 would result in fewer improvements to scenic quality in the long term.

Road Reconstruction and Decommissioning

Approximately 150 miles of existing roads would be reconstructed with Alternative 3. There would be little to no effects from road improvements. Improvements may include, but are not limited to, drainage improvements, tree removal, slight realignments and addition of surfacing materials. Potential effects would be the same as described under Alternative 2.

Approximately 170 miles of temporary roads would be constructed for haul access. These would be decommissioned when treatments are finished. Although the effects of temporary roads would be the same as in Alternative 2, this alternative proposes nearly 50 percent fewer temporary roads, resulting in fewer unnatural linear features in the landscape on a temporary basis. Similar to Alternative 2, this action would have moderate effects on the mapped scenic integrity objective. In High scenic integrity objective, the new temporary road construction would drop these areas one level to Moderate until the roads are decommissioned and begin to naturalize about five years later. Design criteria and best management practices would be used to rehabilitate decommissioned roads and this would hasten their recovery.

Under this alternative up to 200 miles of system road on the Coconino and Apache-Sitgreaves National Forests could be decommissioned. The Tonto National Forest Travel Management EIS has identified approximately 290 miles of road within the Rim Country project area for decommissioning. In addition to system road decommissioning, up to 800 miles of unauthorized roads on all three forests may be decommissioned under this alternative. Following decommissioning, all roads would be allowed to naturalize. Effects would be as described for Alternative 2. Design features and best management practices would be used to rehabilitate these roads. The existing closed roads would naturalize over time and become unnoticeable to the casual observer.

Cumulative Effects

The cumulative effects analysis area is the ponderosa pine forest on the Coconino, Apache-Sitgreaves and Tonto National Forests within the Rim Country project area. The timeline for analysis is 20 to 30 years because most long-term effects of the alternatives are assessed out to a 20-30 year timeframe (with the exception of large-scale high-severity wildfire which is more difficult to project). The following is a list of actions relating to scenic attributes, landscape character, and scenic integrity considered in the cumulative effects analysis for this project:

- Past activities that created the current conditions include grazing, the evolving forest management practices related to timber harvest and fire suppression, drought, disease and insect infestations, and dispersed recreational use.
- Present and future activities such as vegetation management, fire and fuels management, utility corridor clearing and new utility corridors, and other management activities (for example, noxious weeds treatments). These activities could occur on private lands as well.

The cumulative effects of past management activities are visible as the existing conditions. Vegetation management practices, fire suppression, and over grazing have resulted in the current overly dense forests, even-aged forest structure, and sparse understory trees, shrubs, grasses, and forbs.

Alternative 1 – No Action

The short-term cumulative effects (1 to 5 years) from the No Action Alternative, combined with similar current and future restoration treatments and prescribed burning projects, are expected to be negligible unless additional large-scale, high-severity wildfires occur in the ponderosa pine type in the project area. If wildfires burn large areas, the scenic quality would be decreased and there would be long-term negative changes in scenic character. The scenic attributes that contribute to high scenic integrity, such as an open forest with tree groups of varying ages, sizes and shapes; large, mature trees; and healthy, diverse understory would decline or not be present. The scenic effect of a high-severity wildfire would combine with scenic effects from adjacent land development, utility development and/or maintenance, and effects from dispersed recreation use to result in a cumulative effect so that scenic integrity is greatly diminished in areas burned for up to a decade or more. In some places there would be a chance that climate change could contribute to type changes in parts of the ponderosa pine forest so that these characteristics would be replaced with difference landscape characteristics, which would also cumulatively effect scenic attributes.

In the absence of large, high-severity wildfires, long-term cumulative effects of the No Action Alternative and present and future vegetation management activities would be relatively small and localized. In the absence of large-scale treatment, the scale of treatments that are currently accomplished would not result in improvement to scenic integrity. The desired landscape character of an open forest with tree groups of varying sizes, shapes and ages; presence of large, mature trees; and healthy, diverse understory would not be met.

Alternative 2 – Modified Proposed Action

Vegetation management projects would alter the appearance of the landscape where ground-disturbing activities are conducted. Similar to the action alternatives, activities that are very close (300 feet or less) to scenic highways, major travelways, and recreation resources, would have temporary adverse effects on visually sensitive areas. This would increase the chance that people would be exposed to evidence of fire and mechanical thinning activities. Once slash and/or the evidence of fire are reduced, the forest would have a more managed appearance until understory shrubs and trees have provided a more varied appearance, which could be 30 to 40 years.

Individuals who are sensitive to the visual changes of vegetation management and fire-altered landscapes would likely perceive diminished scenic quality. There would be an increased visual presence of roads. When roads are obliterated, the prism would remain for many years. However, once vegetation grows in the road prism, especially trees, it would be less noticeable, and probably only noticed by people walking across or near the road bed. The length of time for recovery ranges from two or three years, to over 50 years, depending on the effectiveness of the decommissioning at deterring travel by off-highway vehicles.

Cumulative effects on scenery resources in the Rim Country project area are expected to meet the visual quality objectives of the forest plans in the short term. In High scenic integrity objective areas, it is expected that any human activities would not be visually evident. In Moderate scenic integrity objective areas, any deviations present would be expected to be subordinate to the characteristic landscape. In Low scenic integrity objective areas any deviations present may dominate the characteristic landscape but would utilize naturally established form, line, color, and texture, and appear natural or compatible to the natural surroundings.

Alternative 2, along with the other past, ongoing, and reasonably foreseeable projects and activities, may have cumulative effects on scenery resources. However, these cumulative effects are expected to meet the visual quality objectives of the forest plans in the short term; no long-term effects are anticipated if the scenery project design features are applied.

Alternative 3 – Focused Alternative

The cumulative effects from Alternative 3 would be similar to those from Alternative 2. There would be slightly fewer negative short-term cumulative effects in localized areas (areas with landings, temporary roads, ground-disturbing activities), since this alternative would mechanically treat and burn fewer acres and require fewer temporary roads. However, there would also be slightly fewer positive long-term cumulative effects in terms of, counteracting drought and insect damage likely to occur as a result of climate change, improved stand structure, and understory improvement, since there would be less mechanical treatment and burning to facilitate greater forest resiliency.

Effects from Rock Pit Use and Expansion

A total of 21 rock pits were identified for use and potential expansion up to 30 percent of their existing footprint. The material from the rock pits may be used for a variety of road maintenance activities, from general maintenance of primary roads to construction or rehabilitation of temporary roads. The proposed use and expansion of rock pits would include hauling of equipment and aggregate materials to and from the pits for use in road maintenance, road construction, and erosion control to aid in implementation of the 4FRI Rim Country project and other projects in the 4FRI footprint.

Effects Common to All Alternatives

Effects common to all alternatives include views of exposed soil at active rock pits locations, and removed vegetation. Active pits would also have processing and mining equipment, and trucks for hauling roadbed material to desired locations. In addition to space for processing equipment, pits requiring processing would also need space to store stockpiles of processed and partially processed materials. The space needed for processing equipment, stockpiling of materials, and loading is included in the footprint of each rock pit site.

Most rock pits are located in Moderate scenic integrity objective in forested areas making them difficult to view even from a foreground distance (300 feet to 0.5 miles). Under both action alternatives, design features would help mitigate the effect on scenery from rock pits.

Alternative 1 - No Action

Under Alternative 1, for implementation of other projects and activities, rock pit activities would continue to mine and process roadbed materials from active existing pits either for maintenance of Forest Service roads, temporary road construction, or through permitted use. Direct effects on visually sensitive areas would be views of exposed soil, removed vegetation, and of trucks and other equipment used to mine and process roadbed material. The magnitude of these direct effects would vary depending on the duration of activities at each existing pit, the number of viewers that are able to see the exposed soil, removed vegetation, and equipment, and the distance from which viewers can observe these project-related activities.

Indirect effects would include long–term views of the pits following mining activity and before re-vegetation efforts have been completed.

Mining and processing activities that occur at any of the pits within 0.5 miles of scenic routes or major travelways, or within 0.5 miles of recreation resource areas, could cause adverse, temporary effects. The importance of these effects can be evaluated in terms of their consistency with scenic integrity objectives. Actively mined pits are consistent with the scenic integrity objective of Moderate since the landscape may appear slightly altered and the pits are visually subordinate when viewed from distances of greater than 0.5 mile, which is the breakpoint between the foreground and middle-ground distances (USDA FS 1996).

Alternative 2 - Modified Proposed Action

Due to the relatively small footprint and locations of the proposed rock pits on the landscape, most direct and indirect visual effects would be very limited to where the pit can be seen from forest roads. Out of the proposed 21 pits, there are 8 pits that are located within 0.5 miles of major travelways or trails. Most of the pits that are located next to a major roadway, recreation site, or trail were initially used to provide material to construct these same roadways, recreation site, or trail. Often the rock pit was built very near the road or trail but in an area not visible to provide for a convenient material source without affecting the viewshed.

Mining and processing activities that occur at any of the pits within 0.5 miles of scenic routes or major travelways, or within 0.5 miles of recreation resource areas, could cause adverse, temporary effects. The importance of these effects can be evaluated in terms of their consistency with scenic integrity objectives. Actively mined pits are consistent with the a Moderate scenic integrity objective since the landscape may appear slightly altered and the pits are visually subordinate when viewed from distances of greater than 0.5 mile, which is the breakpoint between the foreground and middleground distances (USDA FS 1996). In situations where a proposal does not meet scenic integrity objectives or visual quality objectives, the Forest Plan allows for “one classification movement downward…“(USDA FS 1987, p. 60).

Alternative 3 – Focused Alternative

Effects on visually sensitive areas and consistency with scenic integrity objectives would be of the same type as described for Alternatives 1 and 2. As discussed for Alternative 2, these proposed activities would result in some adverse effects on scenic integrity objectives.

Effects from Use of In-woods Processing and Storage Sites

A total of 12 in-woods processing sites are proposed for consideration in this project. Tasks that would be carried out at processing sites include drying, debarking, chipping stems and bark, cutting logs, manufacturing and sorting logs to size, producing wood cants, scaling and weighing logs, and creating poles from suitably sized logs. Equipment types commonly used at processing sites include circular or band saws, various sizes and types of front-end loaders, log loaders, and chippers of several types, and may include processors, planers and mechanized cut to length systems, and associated conveyers and log sorting bunks for accumulation and storage of logs.

Eight processing sites were proposed and analyzed for environmental effects in the Cragin Watershed Protection Project. These sites are carried forward for potential use in implementing the Rim Country Project. An additional 12 processing sites are being analyzed that range in size from four to 21 acres. Most processing sites are located in forested areas making them difficult to view even from a foreground distance (300 feet to 0.5 miles).

Potential sites were screened so as to be located outside of meadows, where some of the most productive forest soils are found, and in relatively flat areas. Other sites are located in existing clearings and flat areas. The siting of processing sites in relatively flat areas would minimize the need for extensive site grading. Processing sites were located to provide for a buffer of 100 to 300 feet from forest roads and state highways to provide for visual screening from Concern Level 1 and 2 travelways. Site boundaries are approximate and may be further modified during implementation and layout.

Following completion of use of processing sites and removal of all equipment and materials, site rehabilitation would have to be accomplished, including removal of aggregate, restoration of pre-disturbance site grades, de-compaction of soil for seedbed preparation, and seeding and mulching of the site with native grasses and forbs.

Alternative 1 - No Action

Alternative 1 proposes no in-woods processing and storage sites and initiates no human-caused changes to the scenic quality within the project area. Alternative 1 would meet the adopted High, Moderate, and Low scenic integrity objectives throughout the project area as it does not create any unnaturally-appearing elements of form, line, color, or texture.

Alternative 2 - Modified Proposed Action

The scenic integrity objectives, adjacent scenic resources, and the visibility of the proposed processing sites were considered from foreground, middleground, and background perspectives. The highest level of detail would likely be perceived from the foreground perspective. However, due to the size and scale of the sites, particularly those of larger acreage, there is the potential for the proposed openings and associated infrastructure to be seen from a distance from sensitive viewing platforms. Thinning around the edges of the processing site boundaries would promote a more naturally-appearing landscape when these sites are seen from a distance.

Low interim scenic integrity objectives would be assigned to these locations during implementation. During implementation, the proposed processing sites would likely be noticeable to the casual observer and, depending on the perspective of the viewer, may dominate the view. Visitors would notice the lack of vegetation and the aggregate surface. Built structures such as fencing, sanitation facilities, office trailers, fuel storage containers, or other temporary structures would likely be noticeable to the casual observer. Heavy equipment, and associated conveyers and log sorting bunks for accumulation and storage of logs may be highly visible from sensitive viewing platforms. For safety, most of the equipment would likely be a yellow color to ensure visibility for the workers, which would create a notable contrast for visitors. The concentration of wood and slash for sorting and drying would be evident to visitors to the near vicinity. Design features would ensure that scenic integrity objectives are met post implementation and effects on scenery are minimized during implementation to the extent practicable. Due to the potential for the soils to be heavily compacted form the operations at these sites, recovery post-implementation may take up to 10 years, depending on the duration and extent of usage of the processing site. The scenic integrity objectives would be met after the sites have been reclaimed and restored to a naturally-appearing landscape character, likely 10 years post treatment.

Alternative 3 - Focused Alternative

Effects on visually sensitive areas and consistency with scenic integrity objectives for Alternative 3 would be similar to those for Alternative 2, as all proposed in-woods processing sites could potentially be utilized. As discussed for Alternative 2, proposed activities would result in some adverse effects on scenic integrity objectives.

Unavoidable Adverse Effects

Though both action alternatives (Alternatives 2 and 3) were designed to move resources toward desired conditions, implementation of either one would result in some unavoidable, short-term, adverse effects. At the same time, implementation of Alternative 1, the no action alternative, would also result in some unavoidable, short-term, adverse effects from forest management activities that are part of other projects and from wildfires that may occur within or near the Rim Country project area.

Adverse effects from implementation of either of the action alternatives would be limited in extent and duration by ensuring that management activities are consistent with standards and guidelines from the forest plans and proposed amendments. Project design features, found in Appendix C, along with mitigations and protocols in Appendix J of the Programmatic Agreement between the Southwestern Region of the Forest Service, the Arizona, New Mexico, Texas and Oklahoma State Historic Preservation Offices and the Advisory Council on Historic Preservation, would apply to both action alternatives and would provide additional means and mitigations to avoid or minimize adverse effects while still meeting the purpose and need of the project.

Implementation of activities in both action alternatives could result in some of the following unavoidable, short-term, adverse effects (further details can be found in the respective resource sections of this chapter):

1. Individuals of some threatened and endangered species, as well as some sensitive species, may be harmed. Habitat for certain species may be temporarily adversely affected.
2. Short-term disturbances to grasses, forbs, shrubs, and small trees may occur.
3. Air quality may temporarily decrease.
4. Erosion and soil compaction may temporarily increase.
5. Water quality may be temporarily affected.
6. Cultural artifacts, features, and sites may be disturbed or damaged.
7. Tribal access to Traditional Cultural Properties and forest products may be temporarily hindered during implementation of treatments.
8. Temporary decreases in access to recreation opportunities and deviations from scenic integrity objectives may occur.
9. Forage availability may decrease temporarily.
10. Noxious weed infestation may increase.

None of the alternatives has expected energy requirements or conservation potential (40 CFR 1502.16(e)).

Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures, as well as means to mitigate adverse environmental effects are discussed in the resource sections of this chapter and in Appendix C (40 CFR 1502.16(f)).

None of the alternatives would affect the design of the built environment. The effects of implementing the alternatives on urban quality and historic and cultural resources (40 CFR 1502.16(g)) are displayed in the Fire Ecology and Air Quality, Tribal Relations, and Heritage Resources Reports and the corresponding sections of this chapter.

There could be short-term, temporary effects on land special uses and mineral projects as site-specific restoration activities were implemented. For example, access to sites may be temporarily restricted while thinning or burning was occurring. The duration of these effects would be only as long as the site-specific activities were occurring – for example, the amount of time that thinning was occurring in the vicinity of a particular permit area or mineral site. Prior to any site-specific implementation, the Forest Service would work with affected permit or claim holders to determine site-specific concerns, such as timing restoration activities to avoid periods of high use or access need by the permit holders. Such mitigation would minimize potential adverse effects on these resources.

Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101). Consistent with the Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. 528-531), the Forest Service manages each national forest to sustain the multiple use of its renewable resources in perpetuity while maintaining the long-term health and productivity of the land. Land management plans (forest plans) guide sustainable, integrated management of the resources within the plan area in the context of the broader landscape, giving due consideration to the relative values of the various resources in particular areas (36 CFR 219.1(b)).

By ensuring that proposed treatment activities and design features in both action alternatives move resources towards desired conditions in a manner consistent with forest plan direction, the long-term productivity of the land would not be impaired by short-term uses associated with implementation of either action alternative. All potential short-term disturbances would be evaluated and mitigated at a site-specific level prior to implementation. This disclosure focuses on soils, water, and vegetation resources. More detailed discussions related to short-term uses and long-term productivity can be found in the effects analysis sections for the individual resources earlier in this chapter and in individual resource specialist reports.

Soils and Water

Implementation of Alternative 1, the no action alternative, would not directly affect soil and water productivity and quality, though it would result in continued loss of soil productivity on, and erosion from, roads that would be decommissioned by implementation of either of the action alternatives. It would do nothing to avoid or decrease undesirable effects on soils and water quality from future wildfires.

Restoration treatments and associated activities, including prescribed fire, in Alternatives 2 and 3 would result in some ground disturbance and would produce short-term, localized effects to soil productivity and water quality. Long-term benefits of treatments in both alternatives would include avoiding or decreasing undesirable effects on soils and water quality from future wildfires and improving overall soil retention and water quality in degraded watersheds. Because of the larger area over which mechanical thinning and prescribed fire treatments would be implemented in Alternative 2, both the short-term effects and long-term benefits to productivity would be greater than those from activities in Alternative 3. Both action alternatives would decommission equal mileages of forest system and unauthorized roads, leading to positive long-term benefits on soil productivity and water quality in the areas around those roads under either alternative.

Vegetation

Alternative 1 would not directly result in short-term effects on the productivity of vegetation. At the same time, it would not address the problems of stagnant tree growth and mortality, or susceptibility to fire and insect or disease outbreaks. Thus it would be expected to lead to declining productivity, if not outright losses of over- and understory species from stand-replacing wildfires and insect or disease outbreaks over the long term.

Implementation of either action alternative would lead to short-term effects on and mortality of vegetation from disturbances associated with implementing restoration treatments. However, restoration treatments would reduce inter-tree competition, improve growth and vigor of residual trees, and increase understory productivity and diversity, including of shade-intolerant species. These treatments would also improve resistance and resilience to wildfires, climate change, and insect and disease outbreaks, thus maintaining or enhancing the long-term productivity of restored ecosystems.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be undone, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time, but are reversible, such as the temporary loss of canopy cover in forested areas that are kept clear for use as a power line right-of-way or road. See discussions of environmental consequences for individual resources earlier in this chapter for more detail.

A likely outcome of Alternative 1 would be one or more high-intensity, stand-replacing wildfires in the project area. Post-fire effects on resources that require decades or longer to recover would constitute irretrievable commitments of those resources in the short term and potentially the long term. For example, topsoil, which is critical to healthy surface vegetation, would take centuries to fully recover. Likewise, the loss of old and large trees would be irretrievable and would require many decades, if not centuries, to recover. Given uncertainties of the effects of climate change and the possibility of post-fire vegetation type conversions from forest to non-forest, the loss of entire stands to wildfires could represent an irreversible commitment of those resources. Cultural resources are non-renewable, and direct damage from high-intensity wildfires, such as spalling of rock art or cracking of artifacts, would represent an irreversible commitment of those resources. In addition, indirect effects of high-intensity wildfires on cultural resources, such as damage from bulldozers used during suppression operations, or exposure following post-fire erosion, can lead to irreversible degradation or losses of cultural resources.

Alternative 1 would not result in additional road decommissioning within the project area beyond what may occur as part of other projects or management activities. Relative to the action alternatives, both of which would include decommissioning of up to 490 miles of existing system roads and 800 miles of unauthorized roads, the lost soil and vegetation productivity associated with continued use of these roads in Alternative 1 would represent an irretrievable commitment of these resources.

Alternatives 2 and 3 include mechanical thinning and prescribed burning on approximately 953,130 and 529,060 acres, respectively. Potential cultural resource damage from thinning, burning, and related activities would represent an irreversible commitment of these resources. Design features and established mitigation measures and protocols would help avoid and minimize potential negative effects on cultural resources.

Alternatives 2 and 3 include the construction of up to 330 and 170 miles of temporary roads, respectively. Decreases in soil and vegetation productivity while these roads are used would represent irretrievable commitments of resources. Inadvertent damage to cultural resources from construction and use of temporary roads would be an irreversible commitment of these resources. Design features, along with established mitigation measures and protocols to protect cultural resources, would help avoid and minimize potential negative effects of construction and use of temporary roads. Temporary roads would be decommissioned when restoration work is completed in the areas to which they provide access.

Alternatives 2 and 3 include the proposed expansion of 11 existing rock pits to provide adequate sources of road surfacing material for project-related activities. The expansion of these pits would represent an irretrievable commitment of resources due to the removal of developed soils needed for vegetative growth on approximately 27 acres. The differences in soil productivity within the pit and in the surrounding area would be distinct and unavoidable, though effects on other resources would be mitigated by using design features. The loss of productive topsoil from rock pit expansion would be offset by decreases in soil erosion on and along roads from the proper maintenance of road surfaces to manage runoff.

Alternatives 2 and 3 include the potential for creation of up to 12 in-woods processing and storage sites to facilitate more utilization of forest resources, increase transportation efficiencies, and reduce implementation costs. The surface area for all 12 processing sites would be 127 acres, with individual sites ranging in size from four to 21 acres. Sites were chosen to minimize potential effects on soils and water quality, and design features were developed to further mitigate potential effects on these and other resources. Nonetheless, the clearing and preparation for use of any of these sites would result in irretrievable commitments of vegetation and soil productivity resources, since vegetation would be cleared and topsoil displaced and compacted if any of these sites are used.

The effects on lands and lands special uses would occur only during the implementation of this project. Once the project was complete, effects would cease. The long-term benefit to structures located on non-National Forest Service lands and those authorized by special use permits would be reduced risk of uncharacteristic fire behavior.

The effects on minerals would be permanent, as consumption of non-renewable mineral resources under this project would remove the availability of these resources in the future.

Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs “To the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with… other environmental review laws and executive orders.”

1. Implementation of restoration activities, temporary road construction, and road decommissioning may require Section 404 permits from the U.S. Army Corps of Engineers and/or Section 401 permits from the Arizona Department of Environmental Quality (ADEQ) or tribes, as required by the Clean Water Act, if they involve dredging or discharging fill into waters of the U.S., or if they may result in discharges to state or tribal waters.
2. In-woods processing and storage sites would likely be regulated as industrial sites subject to permitting under ADEQ’s Multi-Sector General Permit program. This permit program requires that certain industrial facilities implement control measures and develop site-specific stormwater pollution prevention plans to comply with Arizona Pollutant Discharge Elimination System (AZPDES) requirements.
3. All operators at rock pit sites must have or obtain coverage under an AZPDES permit and establish and implement a stormwater pollution prevention plan, if required, to comply with state water requirements based on the magnitude of the specific rock pit operation.
4. Permits for installation of aboveground storage tanks at in-woods processing sites, and for temporary fuel storage tanks used to implement restoration treatments would have to be obtained through the Arizona State Fire Marshall’s Office.
5. Petroleum storage in aboveground containers with a total aggregate capacity of 1,320 gallons or more, would be subject to the Spill Prevention, Countermeasures, and Contingency (SPCC) Rule and an SPCC plan would be required (40 CFR Part 112).
6. Best management practices would be implemented and monitored for all activities with the potential to impair water quality in accordance with the intergovernmental agreement between ADEQ and the Forest Service Southwestern Regional Office to control and manage nonpoint source pollution.
7. All prescribed burning would be coordinated daily with ADEQ to comply with state and federal regulatory requirements and to ensure ADEQ is aware of potential smoke impacts to receptors. Burning would not take place without prior approval from ADEQ.
8. The U.S. Fish and Wildlife Service, in accordance with the Endangered Species Act regulations for projects with threatened or endangered species, provided informal project design input as the alternatives were developed. Formal consultation would begin after the official DEIS comment period.

9. Current denning/rendezvous site locations of Mexican gray wolves and any necessary changes to planned restoration activities due to proximity to those sites would be determined through coordination with the Mexican Wolf Interagency Field Team.
10. If cultural sites are found during pre-implementation surveys or during activity implementation, the Forest Service would follow guidance found at 36 CFR 800.12 and in the Programmatic Agreement between the Southwestern Region of the Forest Service, the Arizona, New Mexico, Texas and Oklahoma State Historic Preservation Offices and the Advisory Council on Historic Preservation. Implementation of this guidance is done in consultation with the AZ State Historic Preservation Office and tribes, if appropriate, and an effort is made to minimize effects to the discovery.
11. In accordance with the National Historic Preservation Act (NHPA), Executive Order 13175, the Programmatic Agreement, and other regulations and policies, the Tonto Tribal Liaison has begun government-to-government consultation for the Rim Country project. Consultation with Native American tribes on the Rim Country project was initiated on August 16, 2016 and would continue throughout the project’s 10- to 20-year life span.
12. Appendix J of the Programmatic Agreement is a protocol for large-scale fuels reduction, vegetation treatment, and habitat improvement projects developed in consultation with and signed by the Regional Forester, all four State Historic Preservation Offices, and the Advisory Council. Appendix J describes the methods to be used to achieve a No Adverse Effect determination for the Rim County analysis as a whole, while providing a strategy for a phased NHPA Section 106 evaluation for individual task orders.
13. Individual task orders, or undertakings, would be inventoried when each specific project area is identified. A NHPA Section 106 report would be produced for each proposed individual undertaking, and all consultation with the AZ State Historic Preservation Office and appropriate tribes would be completed prior to implementing the task order.

See the Law, Regulation, and Policy section earlier in this chapter for more information on applicable laws, regulations, and policies.