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Final Environmental Impact Statement for the Land Management Plan

Tonto National Forest

Volume 2: Chapter 3 (continued), Chapter 4, References, and Glossary

Coconino, Gila, Maricopa, Pinal, and Yavapai Counties, Arizona

Cover photograph: View of Weavers Needle on the Mesa Ranger District; credit: Mark Taylor

Final Environmental Impact Statement for the Land Management Plan

Tonto National Forest

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Contents

Refer to volume 1 for chapters 1, 2 and the first part of chapter 3.

Volume 3 contains Appendix A: Response to Comments.

Volume 4 contains:

Appendix B: Description of the Analysis Process,

Appendix C: Public Engagement and Coordination with Other Planning Efforts,
Appendix D: Wilderness Recommendation Process,
Appendix E: Wild and Scenic Rivers Eligibility Process,
Appendix F: Evaluation of Designated and Proposed Areas,
Appendix G: Analysis of At-Risk Species, and
Appendix H: Plan Components that Maintain or Restore Habitat Connectivity.

Volume 5 contains:
Appendix I: Crosswalk from the 1985 forest plan to revised forest plan.

List of Tables

List of Figures

Chapter 3. Affected Environment and Environmental Consequences (continued)

Wildlife, Fish, and Plants

The Tonto National Forest is home to an enormous diversity of wildlife, plant, and animal species. This is due in part to the diverse ecosystems found across the forest, from vast swaths of Sonoran Desert with its iconic saguaros to the pines and aspens along the rugged Mogollon Rim. The wide-ranging elevation and geography of the Forest leads to a wealth of flora and fauna, some of which are unique, endemic species found only on the Tonto National Forest.

Ensuring the conservation and preservation of these species is an integral part of the Tonto National Forest's mission. The National Forest Management Act of 1976 directs managers of National Forest System lands to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives." While this mandate is particularly challenging, given the complex lives of all living things and their interactions with the environment (both natural and human), the Tonto National Forest is committed to conserving species while also providing for social, economic, and ecological sustainability.

The work of conserving species is guided by specific laws, regulations, and policies that apply to distinct groups of species on the forest. In this analysis we address three categories of protected species:

- at-risk species: includes federally listed threatened and endangered species as well as species of conservation concern;
- regional forester sensitive species; and
- migratory birds, bald eagles, and golden eagles.

This analysis will look at the effects of all the proposed alternatives to evaluate if and how each meets the requirements set forth in corresponding directives and will provide a comparison of environmental effects that may impact species and their habitats.

At-Risk Species

The 2012 Planning Rule directs national forests to develop plan components that provide ecological conditions that: 1) contribute to the recovery of federally listed species, 2) conserve proposed and candidate species, and 3) maintain a viable population of species of conservation concern. In this report, the term *at-risk species* will be used to refer to all three of these categories collectively. At the time of this analysis, however, there are no proposed or candidate species on the forest. Both federally listed and species of conservation concern will be described in greater detail.

The term "ecological conditions[1]" refers to the biological and physical environment that can affect the diversity of plant and animal communities, the persistence of native species, and the productive capacity of ecological systems. Ecological conditions include habitat and the effects of human uses (e.g., roads, structural developments, recreation, grazing, mining, etc.).

[1] defined in FSH 1909.12, zero code, section 05

Federally Recognized Species

Federally listed threatened and endangered species are those plant and animal species formally listed by the US Fish and Wildlife Service under authority of the Endangered Species Act of 1973, as amended. The Endangered Species Act[2], implemented by the Department of the Interior, US Fish and Wildlife Service, recognizes imperiled species and provides for their protection and recovery. At the time of this analysis, there are 19 federally protected species on the Tonto National Forest (table 95).

Section 7 of the Endangered Species Act requires Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to destroy or adversely modify designated critical habitat. Section 7 also requires that any Federal agency that carries out, permits, licenses, funds, or otherwise authorizes activities that may affect a listed species must consult with the US Fish and Wildlife Service to ensure that its actions are not likely to jeopardize the continued existence of any listed species. Federal agencies should establish programs to conserve species and ensure that our actions don't jeopardize the continued existence of species or destroy or adversely modify designated critical habitat. As part of forest plan revision, the Tonto National Forest provided US Fish and Wildlife Service with a biological assessment on the effects of the proposed plan. It provided a detailed, species level assessment of effects to all federally listed species and designated and proposed critical habitats on the forest[3].

[2] 16 U.S.C. Sec. 1531-1544
[3] These reports can be found in the project record.

Table 95. Federally listed species and status

Common Name	Scientific name	Status	Critical habitat	Recovery Plan and Year
Arizona cliffrose	*Purshia subintegra*	Endangered	No designated critical habitat	Recovery Plan; 1995
Arizona hedgehog cactus	*Echinocereus triglochidiatus var. arizonicus*	Endangered	No designated critical habitat	Agency Review Draft; 1984
Chiricahua leopard frog	*Lithobates chiricahuensis*	Threatened	Critical habitat has been designated on the Upper Salt and Lower Verde local zones; habitat is also available in the Tonto zone.	Final Recovery Plan; 2007
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered, experimental population, non-essential	No designated critical habitat	Recover Goals; Amendment to recovery Plan; 2002
Desert pupfish	*Cyprindon macularius*	Endangered	No designated critical habitat	Recovery Plan; 1993
Gila chub	*Gila intermedia*	Endangered	Critical habitat present on western boundary of the Tonto National Forest, Agua Fria River, and tributaries (US Fish and Wildlife Service 2005) (NatureServe 2015f)	Draft Recovery Plan; 2015
Gila topminnow	*Poeciliopsis occidentalis*	Endangered	No designated critical habitat	Revised Recovery Plan; 1984
Gila trout	*Oncorhynchus gilae*	Threatened	No designated critical habitat	Revised Recovery Plan; 2003
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Critical habitat present. Numerous known locations of this species on the Tonto National Forest. The Roosevelt Lake area can be the highest population concentration of breeding territories in Arizona and one of the highest for this species across its breeding range.	Final Recovery Plan; 2002
Spikedace	*Meda fulgida*	Endangered	Critical habitat on northwestern and far eastern boundaries of the Tonto, Fossil Creek, and upper Salt River. Species recently reintroduced to Fossil Creek (NatureServe 2015j, US Fish and Wildlife Service 2012).	Recovery Plan: 1991
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	Threatened	Critical habitat present. CH designated in portions of Salt River, Verde River, Pinto Creek, and Tonto Creek. Pinal Creek not included in final CH rule of 2021.	No Current Recovery Plan
Yuma Ridgeway's rail	*Rallus obsoletus yumanensis*	Endangered	No designated critical habitat. Only 30 acres of potentially suitable habitat are known to occur on the Tonto National Forest	Draft Revision; 2009
Loach minnow	*Tiaroga cobitis*	Endangered	Critical habitat on northwestern and far eastern boundaries of the Tonto, Fossil Creek, and upper Salt River. Species recently reintroduced to Fossil Creek (NatureServe 2015j, US Fish and Wildlife Service 2012).	Recovery Plan; 1991
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Critical habitat present. Several nest sites on the Tonto National Forest. Some sites lost due to large fires.	Revised Recovery Plan; 2012

Common Name	Scientific name	Status	Critical habitat	Recovery Plan and Year
Mexican wolf	*Canus lupus baileyi*	Endangered, experimental population, non-essential	Potential habitat was refined in March of 2015, being split into two categories based on the revised geographic boundaries for the expanded range of the experimental population area (Mexican gray wolf experimental population area; 809 FR 2512, January 16, 2015). Primary habitat are currently those acres of mixed conifer with aspen, pinyon-juniper live oak woodland, ponderosa pine forest types on the portion of Zone 1 of the experimental population area on the Tonto National Forest. Secondary habitat is all remaining acres of ecological response unit types except mines and water in Zone 2 of the experimental population area on the Tonto National Forest.	Revised Draft Recovery Plan; 2017
Narrow-headed gartersnake	*Thamnophis rufipunctatus*	Threatened	Critical habitat present. Final critical habitat was designated on October 21, 2021, and includes portions of Tonto Creek and Canyon Creek.	No Current Recovery Plan
Northern Mexican gartersnake	*Thamnophis eques megalops*	Threatened	Critical habitat present. Final CH rule effective May 28, 2021.	No Current Recovery Plan
Ocelot	*Leopardus pardalis*	Endangered	No designated critical habitat. Potential habitat for ocelot was refined in coordination with the US Fish and Wildlife Service in March 2015 and is based around the location on US Highway 60 where a young adult male ocelot was killed by a vehicle in April 2010. Potential habitat for ocelot is defined as acres of Interior Chaparral, Madrean Encinal Woodlands, and Semi-Desert Grasslands ecological response units on the Globe Ranger District.	Recovery Plan; 2016
Razorback sucker	*Xyrauuchen texanus*	Endangered	Critical habitat mostly in north zone, Tonto Creek, and Verde River watersheds. Also, in upper Salt River in central plan area (NatureServe 2015l, US Fish and Wildlife Service 1991).	Recovery Plan; 2002

Species of Conservation Concern

Species of conservation concern is a new category of at-risk species developed and used by the Forest Service under the 2012 Planning Rule, and are defined as:

> "…a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area." (36 CFR 219.9(c))."

In coordination with the Tonto National Forest, and pursuant to responsibilities and authority under the 2012 Planning Rule[4], the regional forester identified species of conservation concern for the Tonto National Forest (see table 96; for more information on the selection process of species of conservation concern see the Final Assessment Report of Ecological Conditions, Trends, and Risks to Sustainability). This list consists of 52 species (30 plants, 10 invertebrates, 1 fish, 1 amphibian, 2 reptile, 4 birds, and 4 mammals).

The planning rule also directs the forest plan to develop plan components that provide ecological conditions that maintain a viable population of species of conservation concern. The 2012 Rule (36 CFR 219.9(b)) requires that plan components provide ecological conditions necessary to maintain "a viable population" of each species of conservation concern and defines a viable population as, "a population of a species that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments." (36 CFR 219.19). In practice, we identified substantial threats to persistence for species of conservation concern in order to then develop plan components that address such risks. In cases where all known threats were reasonably addressed, it was presumed that necessary conditions for persistence were ultimately maintained.

[4] 36 CFR 219.7(c)(3)

Table 96. Species of conservation concern and identified threats to their long-term persistence

Common Name	Scientific name	Threats to Species Persistence*
A mayfly	*Fallceon eatoni*	Aquatic habitat departure; impacts from recreation activities; invasive, nonnative species; flooding, sedimentation, and runoff; restricted distribution; small population size; water withdrawal
Allen's big-eared bat	*Idionycteris phyllotis*	Loss of old trees, dead trees (snags), downed wood (coarse woody debris), and structure diversity; more frequent or intense drought; recreation impacts to caves, vandalism of caves, mine shaft and adit closures; riparian habitat departure; uncharacteristic, high-intensity fire; water withdrawal
American dipper	*Cinclus mexicanus*	Aquatic habitat departure; flooding, sedimentation, and runoff; invasive, nonnative species; limited available habitat on the forest; small population size; streamflow or channel alterations; uncharacteristic, high-intensity fire; water withdrawal
Ancha mountainsnail	*Oreohelix anchana*	Altered moisture regimes; habitat loss or departure; impacts from livestock grazing; restricted distribution; uncharacteristic, high-intensity fire
Arizona bugbane	*Cimicifuga arizonica* (syn. *Actaea arizonica)*	Altered moisture regimes; flooding, sedimentation, and runoff; habitat loss or departure; high fuel loads; impacts from recreation activities; limited available habitat on the forest; restricted distribution; riparian habitat departure; uncharacteristic, high-intensity fire; unstable or impaired soils, or soil loss
Arizona giant sedge (syn. Cochise sedge)	*Carex ultra*	Loss of streamside vegetation; potential reproductive isolation; restricted distribution; riparian habitat departure; unstable or impaired soils, or soil loss; water withdrawal
Bezy's night lizard	*Xantusia bezyi*	Departed fire regime; highly endemic; poor reproduction; restricted distribution; uncharacteristic, high-intensity fire
Blumer's dock	*Rumex orthoneurus*	Closed canopy state; declining population; departed fire regime; flooding, sedimentation, and runoff; habitat loss or departure; high fuel loads; impacts from livestock grazing; impacts from recreation activities; insects and other pathogens; limited available habitat on the forest; low genetic diversity; restricted distribution; riparian habitat departure; road construction and maintenance; trampling; uncharacteristic, high-intensity fire; unstable or impaired soils, or soil loss
Broadleaf lupine	*Lupinus latifolius* ssp. *Leucanthus*	Altered moisture regimes; aquatic habitat departure; closed canopy state; flooding, sedimentation, and runoff; habitat loss or departure; high fuel loads; invasive, nonnative species; invasive, nonnative species (grasses); restricted distribution; riparian habitat departure; uncharacteristic, high-intensity fire; unlawful collection; unstable or impaired soils, or soil loss; wetland degradation
Chihuahuan sedge	*Carex chihuahuensis*	Impacts from livestock grazing; riparian habitat departure; wetland degradation; invasive, nonnative species; water developments; flooding, sedimentation, and runoff; climate change
Davidson sage	*Salvia davidsonii*	Altered moisture regimes; climate change; restricted distribution; water withdrawal
Fish Creek fleabane	*Erigeron piscaticus*	Habitat loss or departure; impacts from recreation activities; flooding, sedimentation, and runoff; poor watershed condition; restricted distribution; small population size; streambank loss or instability
Fish Creek rock daisy	*Perityle saxicola*	Climate change; closed canopy state; habitat loss or departure; insects and other pathogens; restricted distribution; uncharacteristic, high-intensity fire
Flagstaff beardtongue	*Penstemon nudiflorus*	Habitat loss or departure; highly endemic; restricted distribution; uncharacteristic, high-intensity fire

Common Name	Scientific name	Threats to Species Persistence*
Fossil springsnail	*Pyrgulopsis simplex*	Aquatic habitat departure; fire suppression activities; flooding, sedimentation, and runoff; highly endemic; impacts from livestock grazing; loss of spring water; loss of streamside vegetation; restricted distribution; riparian habitat departure; road construction and maintenance; uncharacteristic, high-intensity fire; vegetation and timber management; water developments
Fringed myotis	*Myotis thysanodes*	Climate change; declining population; insects and other pathogens; departed fire regime; loss of old trees, dead trees (snags), downed wood (coarse woody debris), and structure diversity; mining activity and development; recreation impacts to caves, vandalism of caves, mine shaft and adit closures
Gila rock daisy	*Perityle gilensis* var. *gilensis*	Closed canopy state; departed fire regime; habitat loss or departure; mining activity and development; restricted distribution; uncharacteristic fire in low desert systems; uncharacteristic, high-intensity fire; water developments
Gilded flicker	*Colaptes chrysoides*	Declining population; habitat loss or departure; uncharacteristic, high-intensity fire
Grand Canyon century plant	*Agave phillipsiana*	Impacts from recreation activities; invasive, nonnative species (grasses); poor reproduction; restricted distribution; small population size; soil compaction; uncharacteristic fire in low desert systems; unstable or impaired soils, or soil loss
Hodgson's fleabane	*Erigeron hodgsoniae*	Climate change; closed canopy state; habitat loss or departure; high fuel loads; restricted distribution; small population size; uncharacteristic, high-intensity fire
Hohokam agave	*Agave murpheyi*	Declining population; habitat loss or departure; invasive, nonnative species (grasses); pressures from urbanization outside the forest; small population size; uncharacteristic fire in low desert systems; water withdrawal
Horseshoe deer vetch	*Lotus mearnsii* var. *equisolensis*	Habitat loss or departure; restricted distribution; unstable or impaired soils, or soil loss
James' rubberweed	*Hymenoxys jamesii*	Flooding, sedimentation, and runoff; habitat loss or departure; lack of information necessary for effective conservation; restricted distribution; uncharacteristic, high-intensity fire; unstable or impaired soils, or soil loss
Lowland leopard frog	*Lithobates yavapaiensis*	Declining population; flooding, sedimentation, and runoff; insects and other pathogens; invasive, nonnative species; streamflow or channel alterations; uncharacteristic, high-intensity fire; water withdrawal
Mapleleaf false snapdragon	*Mabrya acerifolia*	Impacts from recreation activities; mining activity and development; pressures from urbanization outside the forest; restricted distribution; water developments
Marsh rosemary	*Limonium limbatum*	Restricted distribution; loss of spring water; riparian habitat departure; more frequent or intense drought
Metcalfe's tick-trefoil	*Desmodium metcalfei*	Restricted distribution; small population size; uncharacteristic, high-intensity fire
Milk Ranch Talussnail	*Sonorella micromphala*	Construction activities; habitat loss or departure; mining activity and development; pesticides or other pollutants; potential reproductive isolation; restricted distribution; small population size; uncharacteristic, high-intensity fire; vegetation and timber management
Monarch butterfly	*Danaus plexippus*	Declining population; loss of milkweed; pesticides or other pollutants; pressures from urbanization outside the forest; riparian habitat departure
Mt. Dellenbaugh sandwort	*Eremogone aberrans* syn. *Arenarwia aberrans)*	Climate change; habitat loss or departure; lack of information necessary for effective conservation; restricted distribution; small population size; uncharacteristic, high-intensity fire
Net-winged midge	*Agathon arizonicus*	Disjunct populations; lack of information necessary for effective conservation; riparian habitat departure

Common Name	Scientific name	Threats to Species Persistence*
Pacific wren	*Troglodytes pacificus*	Lack of information necessary for effective conservation; loss of old trees, dead trees (snags), downed wood (coarse woody debris), and structure diversity; small population size; uncharacteristic, high-intensity fire
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Threat, mining activity and development, recreation impacts to caves, vandalism of caves, mine shaft and adit closures
Pringle's fleabane	*Erigeron pringlei*	Habitat loss or departure; restricted distribution; uncharacteristic, high-intensity fire
Richinbar talussnail	*Sonorella ashmuni*	Altered moisture regimes: aquatic habitat departure: climate change: mining activity and development: streamflow or channel alterations: uncharacteristic, high-intensity fire: vegetation and timber management
Ripley wild buckwheat	*Eriogonum ripleyi*	Disjunct populations; habitat loss or departure; impacts from livestock grazing; lack of information necessary for effective conservation; limited available habitat on the forest; off-road vehicle use; restricted distribution; unstable or impaired soils, or soil loss; water developments
Roosevelt talussnail	*Sonorella rooseveltiana (+ S.r. fragilis)*	Altered moisture regimes; aquatic habitat departure; climate change; mining activity and development; streamflow or channel alterations; uncharacteristic, high-intensity fire; vegetation and timber management
Roundtail chub	*Gila robusta*	Aquatic habitat departure; declining population; fire suppression activities; habitat loss or departure; impacts from livestock grazing; invasive, nonnative species; poor watershed condition; restricted distribution; riparian habitat departure; road construction and maintenance; streamflow or channel alterations; uncharacteristic, high-intensity fire; vegetation and timber management; water developments; water withdrawal
Rusby's milkwort	*Polygala rusbyi (*syn. *Rhinotropis rusbyi)*	Habitat loss or departure; limited available habitat on the forest; potential reproductive isolation; restricted distribution; small population size; unstable or impaired soils, or soil loss
Salt River rock daisy	*Perityle gilensis* var. *salensis*	Habitat loss or departure; restricted distribution; small population size; uncharacteristic, high-intensity fire; water developments
Senator Mine alumroot	*Heuchera eastwoodiae*	Restricted distribution; uncharacteristic, high-intensity fire
Sierra Ancha fleabane	*Erigeron anchana*	Climate change; habitat loss or departure; flooding, sedimentation, and runoff; restricted distribution; uncharacteristic, high-intensity fire
Sierra Ancha talussnail	*Sonorella anchana*	Construction activities; lack of information necessary for effective conservation; pesticides or other pollutants; restricted distribution; road construction and maintenance; vegetation and timber management
Sonoran desert tortoise	*Gopherus morafkai*	Construction activities, impacts from recreation activities, more frequent or intense drought, off-road vehicle use, uncharacteristic fire in low desert systems
Sonoran maiden fern	*Thelypteris puberula* var. *sonorensis*	Impacts from livestock grazing; loss of spring water; more frequent or intense drought; restricted distribution; small population size; unlawful collection; wetland degradation
Tonto Basin agave	*Agave delamateri*	Declining population; insects and other pathogens; invasive, nonnative species (grasses); lack of information necessary for effective conservation; poor reproduction; potential reproductive isolation; restricted distribution; uncharacteristic fire in low desert systems; uncharacteristic, high-intensity fire; unstable or impaired soils, or soil loss
Toumey groundsel	*Packera neomexicana var. toumeyi*	Lack of information necessary for effective conservation; potential reproductive isolation; restricted distribution

Common Name	Scientific name	Threats to Species Persistence*
Verde Rim springsnail	*Pyrgulopsis glandulosa*	Flooding, sedimentation, and runoff; impacts from livestock grazing; invasive, nonnative species; loss of spring water; restricted distribution; trampling; uncharacteristic, high-intensity fire; water withdrawal
Western red bat	*Lasiurus blossevilli*	Declining population, more frequent or intense drought, poor watershed condition, riparian habitat departure, streamflow or channel alterations, uncharacteristic, high-intensity fire, water developments
Yellow-eyed junco	*Junco phaeonotus*	Habitat loss or departure; restricted distribution; small population size; uncharacteristic, high-intensity fire

*Refer to appendix G in volume 4 for how threats are addressed by plan components.

Affected Environment

We conducted an in-depth assessment of federally listed species and species identified as species of conservation concern in order to identify threats to each species' persistence or recovery in the plan area. Where possible we assessed population trends, identified relevant ecological response units, and other key habitat elements. As part of a risk assessment for each of these at-risk species, a wide variety of ecological conditions (both coarse and fine filter) currently pose risks to the recovery of federally listed species or the long-term persistence of species of conservation concern on the forest. In the following analysis, these risk factors have been grouped by relatedness in order to analyze the conditions these species need in order to be secure in the future. These broad categories include:

- departed habitats: ecological response unit analysis
- poor watershed and riparian conditions
- undesirable fire effects
- disturbance from vegetation and timber management activities
- invasive species, disease, and other pathogens
- recreation impacts
- mining and energy impacts
- grazing impacts
- facilities, roads, construction, and motorized access
- pesticides and pollutants
- rare endemics, small populations, and restricted distribution

While these categories are used throughout the rest of our assessment in order to understand overarching effects between alternatives, the primary requirement to provide ecological conditions that contribute to the recovery of federally listed species and the maintenance of viable populations of species of conservation concern applies equally to all alternatives. As such, we have documented how specific plan components from the revised plan address each threat to persistence or recovery for each at-risk species on the forest. For this complete crosswalk and analysis of plan components that address ecological conditions associated each at-risk species, see appendix G in volume 4. Additionally, tables with plan components that address specific threats are found at the end of each of the following analysis sections.

Environmental Effects[5]: Habitats and Ecosystem Dynamics (Coarse-filter)

Departed Habitats: Analysis of Ecological Response Units

Affected Environment

Many ecological response units on the forest are departed from reference conditions[6]. In a number of these vegetative communities, this has occurred due to changes in historical fire regimes. Woodland and forested ecological response units on the forest generally evolved to experience frequent fire, however,

[5] All assumptions and methods used for this analysis can be found in volume 4, appendix B of the environmental impact statement.

[6] A complete description of the existing condition of ecological response units on the Tonto National Forest, along with the analysis of the effects, by alternative, to these units can be found in the section Ecological Response Units in volume 1. The following analysis takes those conclusions as part of the basis for this analysis.

historical fire exclusion has resulted in larger patch sizes, high stand densities (trees and shrubs), a loss of grass and forb diversity, have an overall reduction of herbaceous cover, and are more prone to atypical wildfires (generally high severity fires). Also, these ecological response units have lower structural diversity where, on average, more acres are in closed-canopy-states (specifically forested ecological response units). These changes can negatively impact wildlife species as they generally benefit from a diversity of structural attributes (canopy complexity, forest patchiness, etc.).

Desert ecosystems on the Tonto National Forest (Mojave Sonoran Desert Scrub and Sonora-Mojave Mixed Salt Desert Scrub ecological response units) make up a significant proportion of the forest. These systems largely evolved without fire as a key ecological process and therefore many species are not fire adapted (such as succulents). Historically, when fires did occur, negative impacts were minimal because naturally occurring fuel loads (patches of vegetation) were separated by large un-vegetated interspaces that limited the spread of fires. Past land use practices, such as the increase in forage for grazing during the late 19th and early 20th centuries, and other activities (ground disturbance activities, off road vehicle use, roads and trail construction and use) have influenced the introduction of exotic and invasive species and increased wildfires in these systems. As exotics, such as annual grasses and forbs, increase in these systems, fuel loads shift from discontinuous to contiguous patches and result in higher wildfire risk.

Native grasses have been replaced with exotic and invasive species for many ecological response units on the forest which lowers site productivity, reduces soil productivity and are not as effective in the prevention of erosion (especially during droughts) or as productive for forage. Soil loss can lead to shifts in species composition with increases in shallow rooted grasses which are less effective in stabilizing soils. These shifts and increases in bare soil can lead to the increased chance of invasive species infestations and lower biodiversity.

Summary and Comparison of Environmental Effects for all Ecological Response Units

Alternative A

Generally, frequent fire ecological response units would remain highly departed under this alternative, increasing risks for species associated with these systems. Many at-risks species that live in these habitats are at-risk from uncharacteristic fires, either directly from high severity fire effects or indirectly from the lack of diverse structural elements that come from dense, even-age stands. Canopy cover would also be greatest under this alternative. Ground cover and erosion are greater risks for most ecological response units, especially in semi-desert grasslands. Other lower elevation ecological response units would make little progress towards desired conditions as the current plan does not contain many specific standards, guidelines, or objectives for them. Fire management in desert systems would seek to minimize impacts, but not focus on suppression.

Alternative B

Fire regimes and seral state departures for frequent fire forest improve significantly under this alternative. Woodland ecological response units would also improve, but remain slightly departed. An overall decrease in canopy cover allows for increased vegetative cover and biodiversity, which in turn adds foraging habitat for many species that prefer multi-age stands. Increased objectives for treating invasive species also contributes to better habitat conditions for many at-risk species, especially in low desert systems where these contribute to increased risk of fire.

Alternative C

The effects of alternative C on most ecological response units would be similar to those in alternative B; however, the primary reliance on fire as the key restoration tool may challenge implementation efforts when accounting for burn windows. There would be no mechanical treatments in woodlands and these systems would remain departed as would semi-desert grasslands. Desert ecological response units would maintain low departure, but undesirable fire and invasive species are likely to be reduced with treatments. Overall, this alternative does a great deal to improve important habitats for at-risk species.

Alternative D

This alternative treats substantially fewer acres in frequent fire and wooded systems, largely due to the cost of focusing primarily on mechanical treatments. Without fire, maintaining treatments would be more costly, and repeated entry by mechanical equipment would likely lead to increased impacts to soils and vegetation. Desert ecological response units would likely remain at lower departure and in similar conditions as in the other alternatives. This alternative is generally leaves more ecological response units in higher departure and at greater risk. At-risks species struggling or at risk of departed fire regimes or even-aged/closed canopy conditions may be reduced or extirpated at some sites. Uncharacteristic fire effects may threaten species with limited distributions.

Conclusion

Because ecosystem integrity and diversity are often tied the health of vegetative communities, including an assessment of vegetative characteristics by alternative provides a coarse-filter insight into the habitat scenarios for each ecological response unit and associated at-risk species. On average, alternative B is the most efficient and speedy option for moving towards desired conditions for all the variables considered. It is likely to contribute as well and frequently better than other alternatives. The main exception, semi-desert grasslands, is projected to move away from away from desired conditions in all alternatives. Though several at-risk species are associated with these systems, none appear entirely dependent on grasslands.

Alternative C is the next most likely alternative to contribute to ecosystem integrity and diversity, and almost all ecological response units were projected to move towards desired conditions in all categories. Alternative D also moves most ecological response units towards desired conditions, though likely at a slower pace than B and C. For a few systems (i.e., juniper grass, pinyon-juniper, and Madrean encinal woodland), alternative D is projected to result in further departure for all the characteristics analyzed. Alternative A is the least likely to provide ecosystem integrity and diversity based on the vegetation and fire analysis.

Plan Components that Provide Ecological Conditions for At-risk Species

Table 97 describes threats to persistence associated with departed ecological response units for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 97. Plan components that address threats to at-risk species related to ecological response unit (ERU) departure

Threats to Persistence	Species Affected	Desired Conditions	Objectives, Standards, Guidelines
closed canopy state	Blumer's dock, broadleaf lupine, Fish Creek rock daisy, Gila rock daisy, Hodgson's fleabane	ERU-DES-DC-01; ERU-DES-DC-02; ERU-IC-DC-01; ERU-IC-DC-01; ERU-MEW-DC-01; ERU-MEW-DC-01; ERU-MEW-DC-02; ERU-MCD-DC-02; ERU-PJC-DC-01; ERU-PJC-DC-02; ERU-PJJUG-DC-01; ERU-PJJUG-DC-04; ERU-PJO-DC-01; ERU-PJO-DC-04; ERU-PPF-DC-04; ERU-PPE-PG-DC-01; ERU-PPE-SS-DC-04; ERU-SDG-DC-01; ERU-MCW-DC-01; ERU-MCW-DC-02	None
habitat fragmentation	Gila trout, Ocelot	LA-DC-01; RMZ-DC-07; WAT-DC-09	RD-G-05; WFP-G-07; WFP-G-08; REC-WR-G-03
habitat loss or departure	Ancha mountainsnail, Aravaipa sage, Arizona bugbane, Blumer's dock, broadleaf lupine, Chiricahua leopard frog, Colorado pikeminnow, desert pupfish, Fish Creek fleabane, Fish Creek rock daisy, Flagstaff Beardtongue, Gila chub, Gila rock daisy, Gila topminnow, Gila trout, gilded flicker, Hodgson's fleabane, Hohokam agave, Horseshoe deer vetch, James' rubberweed, loach minnow, Mexican spotted owl, Milk Ranch Talussnail, Mt. Dellenbaugh sandwort, narrow-headed gartersnake, Northern Mexican gartersnake, ocelot, Pringle's fleabane, Ripley wild buckwheat, roundtail chub, Rusby's milkwort, Salt River rock daisy, Sierra Ancha fleabane, Sonoran desert tortoise, southwestern willow flycatcher, spikedace, yellow-eyed junco, Yuma Ridgeway's rail	See Vegetation and Ecological Response Units section	See Vegetation and Ecological Response Units section
loss of native species (e.g., milkweed or willows)	Monarch butterfly	ERU-DES-DC-04; RNBAMA-DC-07; GRZ-DC-03; ERU-DC-14; WFP-DC-01; WFP-DC-07; WFP-DC-08	INS-G-05; WFP-O-01; WFP-O-02; WFP-G-03; WFP-G-04; WFP-G-07
loss of old trees, dead trees (snags), downed wood (coarse woody debris), and structure diversity	Allen's big-eared bat, Mexican spotted owl, fringed myotis, Pacific wren	ERU-MCD-DC-03; ERU-PPF-DC-01; ERU-PPF-DC-02; ERU-PPE-PG-DC-02; ERU-PPE-PG-DC-02; ERU-PPE-PG-DC-06; ERU-PPE-SS-DC-01; ERU-PPE-SS-DC-02; ERU-DC-05; ERU-MCW-DC-01	FP-G-01; FP-S-03; FP-G-03; FP-S-05; FP-G-05; FP-S-06; FP-S-07; ERU-PPE-G-02; ERU-MCD-G-01; ERU-PPF-G-02; RMZ-G-06; ERU-G-09; ERU-G-13; ERU-G-16; ERU-MCW-G-01

Summary and Comparison of Environmental Effects by Ecological Response Unit

Table 97 addresses specific aspects of departure related to vegetative communities and table 98 through table 109 summarizes the analysis for each of the ecological response units found on the Tonto National Forest, and is a more detailed look at the summarized content above. Each description includes a projected estimate of whether an ecological response unit moves towards or away from desired conditions per each of the alternatives. In addition, if a table cell also includes an asterisk this indicates a faster rate of change; two asterisks indicates the fastest rate of change. Five key ecosystem characteristics are evaluated, including: 1) vegetation structure/seral state proportion, closed versus open conditions; 2) grasslands, herbaceous, and ground cover; 3) fire regime; 4) patch size; and 5) ecosystem function.

Following each ecological response unit is a list of associated at-risk species which depend on the integrity of the corresponding ecosystems. For the complete assessment of ecological response units by alternative, please see the section Ecological Response Units in volume 1 and Resource Assumptions and Methods for Vegetation Ecological Response Units and Fire and Fuels (volume 4, appendix B).

Desert Ecological Response Units

Table 98. Comparison of expected effects to desert ecological response units for each alternative.

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Towards	Towards	Towards
Patch size	No Change	No Change	No Change	No Change
Fire regime	Away	Towards	Towards	Towards
Grasslands, herbaceous, and ground cover	Away	Towards	Towards	Towards
Ecosystem Function	Away	Towards	Towards	Towards

At-risk species associated with desert ecological response units include: Allen’s big-eared bat, Arizona cliffrose, Bezy’s night lizard, Davidson sage, Fish Creek rock daisy, fringed myotis, Gila rock daisy, gilded flicker, Grand Canyon century plant, Hohokam agave, Horseshoe deer vetch, mapleleaf false snapdragon, monarch butterfly, Ripley wild buckwheat, Rusby's milkwort, Salt River rock daisy, Sonoran desert tortoise, Tonto Basin agave.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (coarse-filter ecological conditions) for the above species, see the section on Desert Ecosystems (ERU-DES) in the forest plan, and refer to landscape and midscale desired conditions (ERU-DES-DC).

Semi-Desert Grasslands

Table 99. Comparison of expected effects to semi-desert grasslands for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Away	Away	Away
Patch size	Away	Away	Away	Away
Fire regime	Away	Away	Away	Away
Grasslands, herbaceous, and ground cover	Away	Away	Away	Away
Ecosystem Function	n/a	n/a	n/a	n/a

At-risk species associated with the semi-desert grasslands ecological response unit include: Arizona cliffrose, Bezy's night lizard, fringed myotis, gilded flicker, horseshoe deer vetch, monarch butterfly, pale Townsend's big-eared bat, Ripley wild buckwheat, Rusby's milkwort, and Sonoran desert tortoise.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, see the Semi-Desert Grasslands (ERU-SDG) section in the forest plan, and refer to the landscape and midscale desired conditions (ERU-SDG-DC) and guidelines (ERU-SDG-G).

Interior Chaparral

Table 100. Comparison of expected effects to interior chaparral for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards	Towards	Towards
Patch size	Towards	Towards	Towards	Towards
Fire regime	Towards	Towards	Towards	Towards
Grasslands, herbaceous, and ground cover	Towards	Towards	Towards	Towards
Ecosystem Function	Towards	Towards	Towards	Towards

At-risk species associated with interior chaparral include: Aravaipa sage, Arizona hedgehog cactus, Bezy's night lizard, broadleaf lupine, Fish Creek fleabane, fringed myotis, Gila rock daisy, Hodgson's fleabane, Hohokam agave, monarch butterfly, Pringle's fleabane, Salt River rock daisy, Sierra Ancha fleabane, Tonto Basin agave, Toumey groundsel.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, see the Interior Chaparral (ERU-IC) section in the forest plan, and refer to the landscape, midscale, and fine scale desired conditions (ERU-IC-DC).

Pinon-Juniper Woodland

Table 101. Comparison of expected effects to pinon-juniper woodland for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards	Towards	Towards
Patch size	Away	Towards	Towards	Towards

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Fire regime	No Change	Away	Away	Away
Grasslands, herbaceous, and ground cover	Away	Towards	Towards	Towards
Ecosystem Function	No Change	No Change	No Change	No Change

At-risk species associated with pinon juniper woodland include: Allen’s big-eared bat, Arizona giant sedge (syn. Cochise sedge), fringed myotis, monarch butterfly, Mt. Dellenbaugh sandwort, Pringle's fleabane.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, see the Pinyon-Juniper Woodland (ERU-PJO) section in the forest plan, and refer to the landscape and midscale desired conditions (ERU-PJO-DC).

Juniper Grass and Pinyon-Juniper Grass

Table 102. Comparison of expected effects to juniper grass for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution: open and closed states	Towards	Towards*	Towards	Towards
Patch size	Away	Towards*	Towards	Away
Fire regime	Away	Towards*	Towards	Away
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards	Away
Ecosystem Function	Away	Towards*	Towards	Away

*An asterisk indicates a faster rate of change; two asterisks indicates the fastest rate of change.

Table 103. Comparison of expected effects to pinyon-juniper grass for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards*	Towards	Away
Patch size	Away	Towards*	Towards	Away
Fire regime	Away	Towards*	Towards	Away
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards	Away
Ecosystem Function	Away	Towards*	Towards	Away

*An asterisk indicates a faster rate of change; two asterisks indicates the fastest rate of change.

At-risk species associated with juniper grass and pinyon-juniper grass include: fringed myotis, Gila rock daisy, Grand Canyon century plant, Metcalfe's tick-trefoil, Mexican spotted owl, Mexican wolf, monarch butterfly, Pringle's fleabane, Salt River rock daisy, Tonto Basin agave.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with these ecological response units, see the Pinyon-Juniper Grass and Juniper Grass (ERU-PJJUG) sections in the forest plan, specifically the landscape, midscale, and fine-scale desired conditions (ERU-PJJUG-DC) and guidelines (ERU-PJJUG-G).

Madrean Encinal Woodland and Madrean Pinyon-Oak Ecological Response Units (ERU-MEWMPO)

Table 104. Comparison of expected effects to Madrean encinal woodland and Madrean pinyon-oak for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Towards*	Towards	Away
Patch size	Away	Towards*	Towards	Away
Fire regime	Away	Towards*	Towards	Away
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards	Away
Ecosystem Function	Away	Towards*	Towards	Away

*An asterisk indicates a faster rate of change; two asterisks indicates the fastest rate of change.

At-risk species associated with Madrean Encinal Woodland and Madrean Pinyon-Oak include: Aravaipa sage**,** Arizona hedgehog cactus, Blumer's dock, fringed myotis, monarch butterfly, ocelot, Toumey groundsel, yellow-eyed junco.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, see section Madrean Encinal Woodland and Madrean Pinyon-Oak Ecological Response Units (ERU-MEWMPO) in the forest plan, including landscape (ERU-MEW-DC), midscale (ERU-MEW-DC), and fine-scale desired conditions (ERU-MEW-DC).

Pinyon-Juniper Evergreen Shrub (PJC)

Table 105. Comparison of the expected effects of each alternative on pinyon-juniper evergreen shrub

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards**	Towards*	Towards
Patch size	No Change	Towards	Towards	Towards
Fire regime	Away	Towards	Towards	Towards
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards**	Towards
Ecosystem Function	Away	Towards	Towards	Towards

*An asterisk indicates a faster rate of change; two asterisks indicates the fastest rate of change.

At-risk species associated with pinyon - juniper evergreen shrub: Allen’s big-eared bat, Aravaipa sage, Fish Creek rock daisy, fringed myotis, Hodgson's fleabane, Mexican spotted owl, Mexican wolf, monarch butterfly, Pringle's fleabane, Sierra Ancha fleabane, Toumey groundsel

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, see section Pinyon-Juniper Evergreen Shrub (ERU-PJC) in the forest plan. Desired conditions (ERU-PJC-DC) are at three scales: landscape, midscale, and fine-scale.

Ponderosa Pine – Evergreen Oak (PPE)

Table 106. Comparison of expected effects to ponderosa pine-evergreen oak for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards**	Towards*	Towards*
Patch size	Towards	Towards**	Towards*	Towards*
Fire regime	Towards	Towards**	Towards*	Towards
Grasslands, herbaceous, and ground cover	Towards	Towards**	Towards*	Towards*
Ecosystem Function	Towards	Towards**	Towards*	Towards

*An asterisk indicates a faster rate of change; two asterisks indicates the fastest rate of change.

At-risk species associated with ponderosa pine-evergreen oak: Allen's big-eared bat, Ancha mountainsnail, Arizona bugbane, Blumer's dock, Flagstaff beardtongue, fringed myotis, Gila rock daisy, Hodgson's fleabane, James' rubberweed, Metcalfe's tick-trefoil, Mexican spotted owl, Mexican wolf, Milk Ranch Talussnail, monarch butterfly, Mt. Dellenbaugh sandwort, Pringle's fleabane, Senator Mine alumroot, Sierra Ancha fleabane, Sierra Ancha talussnail, Toumey groundsel.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, see section Ponderosa Pine-Evergreen Oak (ERU-PPE) in the forest plan, including landscape, midscale, and fine-scale desired conditions (ERU-PPE-PG-DC).

Ponderosa Pine Forest (PPF)

Table 107. Comparison of expected effects to Ponderosa Pine Forest for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards**	Towards*	Towards*
Patch size	Towards	Towards**	Towards*	Towards*
Fire regime	Towards	Towards**	Towards*	Towards
Grasslands, herbaceous, and ground cover	Towards	Towards**	Towards*	Towards*
Ecosystem Function	Towards	Towards**	Towards*	Towards

*An asterisk indicates a faster rate of change; two asterisks indicates the fastest rate of change.

At-risk species associated with ponderosa pine forest: Allen's big-eared bat, Blumer's dock, Broadleaf lupine, Flagstaff Beardtongue, fringed myotis, Metcalfe's tick-trefoil, Mexican spotted owl, Mexican wolf, monarch butterfly, Mt. Dellenbaugh sandwort, Senator Mine alumroot.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, see the Ponderosa Pine Forest (ERU-PPF) section in the forest plan and refer to the landscape, midscale, and fine-scale desired conditions (ERU-PPF-DC) and guidelines (ERU-PPF-G).

Mixed Conifer with Frequent Fire (Dry Mixed Conifer-MCD)

Table 108. Comparison of expected effects to mixed conifer with frequent fire (dry mixed conifer) for each alternative.

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards**	Towards*	Towards*
Patch size	Towards	Towards**	Towards*	Towards*
Fire regime	Towards	Towards**	Towards*	Towards
Grasslands, herbaceous, and ground cover	Towards	Towards**	Towards*	Towards*
Ecosystem Function	Towards	Towards**	Towards*	Towards

*An asterisk indicates a faster rate of change; two asterisks indicates the fastest rate of change.

At-risk species associated with mixed conifer with frequent fire: Ancha mountainsnail, Arizona bugbane, Blumer's dock, broadleaf lupine, Metcalfe's tick-trefoil, Mexican spotted owl, Mexican wolf, monarch butterfly, Senator Mine alumroot, yellow-eyed junco.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, see the Mixed Conifer-Frequent Fire (ERU-MCD) section in the forest plan, and refer to the landscape, midscale, and fine-scale desired conditions (ERU-MCD-DC) and guidelines (ERU-MCD-G).

Wet Mixed Conifer/Mixed Conifer with Aspen (ERU-MCW)

Table 109. Comparison of the expected effects of each alternative on wet mixed conifer/mixed conifer with aspen

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Towards	Towards	Towards
Patch size	Away	Towards	Towards	Towards
Fire regime	Away	Towards	Towards	Towards
Grasslands, herbaceous, and ground cover	Away	Towards	Towards	Towards
Ecosystem Function	Away	Towards	Towards	Towards

At-risk species associated with wet mixed conifer/mixed conifer with aspen: Ancha mountainsnail**,** Arizona bugbane, Blumer's dock, broadleaf lupine, Metcalfe's tick-trefoil, Mexican spotted owl, Mexican wolf, monarch butterfly, Senator Mine alumroot, yellow-eyed junco.

Plan Components that Provide Ecological Conditions for At-risk Species

For specific plan components that provide for ecosystem integrity and ecosystem diversity (i.e., coarse-filter ecological conditions) for the above species associated with this ecological response unit, refer to the Wet Mixed Conifer/Mixed Conifer with Aspen (ERU-MCW) section in the forest plan for landscape, midscale and fine-scale desired conditions (ERU-MCW-DC) and guidelines (ERU-MCW-G).

Poor Watershed and Riparian Conditions

Affected Environment

Aquatic and riparian systems are at significant risk across the Forest[7]. Shallow water tables, cooler temperatures, and greater productivity typically characterize these systems. However, human alterations to the landscape such as impoundments, diversions and pumping, introduction of invasive plants, grazing, and recreational impacts are altering these systems. Roads, grazing, and recreational uses (including trails and dispersed recreation) remove vegetation and compact soils in riparian areas, causing significant departures from reference condition in terms of species composition, proportion of bare soils, and stream bank stability, ultimately causing erosion and sedimentation downstream.

Increased water demand (water withdrawal) and climatic changes (e.g., long-term drought) have also affected these systems. Water tables are lower and there have been decreases in periodic flooding which is necessary for the regeneration of some important riparian species (e.g., cottonwood). This results in shifts in species composition and a reduction in available soil moisture. Bare soil and reduced native species provide conditions suitable for establishment of invasive species. Invasive species, in combination with adjacent uncharacteristically dense upland vegetation, lead to an increased risk of fire from the uplands entering riparian areas, where fire is not a natural part of the ecosystem. Loss of riparian vegetation leads to higher water temperatures, increased erosion and sedimentation, and an overall decrease in water quality which negatively affects aquatic biota and wildlife. The impact on wildlife is significant; an endangered species that is a riparian obligate and fifteen species of conservation concern are dependent on the riparian area for their habitat.

Both natural and human caused disturbances impact the condition of water resources across the forest. Although some wildfires are a natural disturbance, high burn severity areas within wildfires from both natural and man-caused ignitions lead to increased rates of erosion and sedimentation, negatively impacting water quality. Drought also impacts water resources through reduced flow in streams and springs. Roads in close proximity to stream channels increase delivery of water and sediment to stream networks on and off the Forest. Likewise, grazing, recreation, and other multiple uses continue to impact water resources into the future.

Human-caused and natural disturbances across the landscape result in water quality designation of 34 percent of the assessed stream miles on the forest as not attaining or impaired. Impairments vary but can include heavy metals, sediment, nutrients, dissolved oxygen, bacteria and mercury in fish tissues.

The majority of the sub-watersheds on the forest, 89 percent, are classified as functioning-at-risk or impaired. Water quantity, aquatic habitat, aquatic biota, riparian vegetation, roads and trails, and soil condition are the watershed conditions indicators that have the greatest impact on overall watershed condition scores.

Habitat modification and fragmentation has occurred from dam construction, conversion to agricultural uses, dewatering, road construction, cattle grazing, and timber harvest. Additionally, catastrophic wildfires have led to declines in the distribution and abundance of native aquatic biota. Wildfires followed by monsoon rains can cause flooding that carries ash that can kill fish and severely alter habitats, often

[7] A complete description of the existing condition of ecological response units on the Tonto National Forest, along with the analysis of the effects, by alternative, to these units can be found in the Riparian Areas section of this environmental impact statement. The following analysis takes those conclusions as part of the basis for this analysis.

taking years to recover. As a result of all disturbances, native species have been reduced from a large, interconnected population to isolated populations in remote headwater streams that are difficult to access.

Table 110. Species considered at risk due to poor watershed and riparian conditions

Common name	Scientific name	Taxonomic group	At-risk species status
Allen’s big-eared bat	*Idionycteris phyllotis*	mammal	species of conservation concern
A mayfly	*Fallceon eatoni*	invertebrate	species of conservation concern
American dipper	*Cinclus mexicanus*	bird	species of conservation concern
Ancha mountainsnail	*Oreohelix anchana*	invertebrate	species of conservation concern
Aravaipa sage	*Salvia amissa*	plant	species of conservation concern
Arizona bugbane	*Cimicifuga arizonica (syn. Actaea arizonica)*	plant	species of conservation concern
Arizona giant sedge (syn. Cochise sedge)	*Carex ultra*	plant	species of conservation concern
Arizona hedgehog cactus	*Echnocereus triglochidiatus var. arizonicus*	plant	endangered
Blumer's dock	*Rumex orthoneurus*	plant	species of conservation concern
Broadleaf lupine	*Lupinus latifolius ssp. Leucanthus*	plant	species of conservation concern
Chihuahuan sedge	*Carex chihuahuensis*	plant	species of conservation concern
Chiricahua leopard frog	*Lithobates chiricahuensis*	amphibian	threatened
Colorado pikeminnow	*Ptychocheilus lucius*	fish	endangered, experimental population, non-essential
Davidson sage	*Salvia davidsonii*	plant	species of conservation concern
Desert pupfish	*Cyprindon macularius*	fish	endangered
Fish Creek fleabane	*Erigeron piscaticus*	plant	species of conservation concern
Fossil springsnail	*Pyrgulopsis simplex*	invertebrate	species of conservation concern
Gila chub	*Gila intermedia*	fish	endangered
Gila rock daisy	*Perityle gilensis var. gilensis*	plant	species of conservation concern
Gila topminnow	*Poeciliopsis occidentalis*	fish	endangered
Gila trout	*Oncorhynchus gilae*	fish	threatened
Hodgson's fleabane	*Erigeron hodgsoniae*	plant	species of conservation concern
Hohokam agave	*Agave murpheyi*	plant	species of conservation concern
James' rubberweed	*Hymenoxys jamesii*	plant	species of conservation concern
Loach minnow	*Tiaroga cobitis*	fish	endangered
Lowland leopard frog	*Lithobates yavapaiensis*	amphibian	species of conservation concern
Mapleleaf false snapdragon	*Mabrya acerifolia*	plant	species of conservation concern
Marsh rosemary	*Limonium limbatum*	plant	species of conservation concern
Mexican spotted owl	*Strix occidentalis lucida*	bird	threatened
Mexican wolf	*Canus lupus baileyi*	mammal	endangered, experimental population, non-essential

Common name	Scientific name	Taxonomic group	At-risk species status
Monarch butterfly	*Danaus plexippus*	invertebrate	species of conservation concern
Narrow-headed gartersnake	*Thamnophis rufipunctatus*	reptile	threatened
Net-winged midge	*Agathon arizonicus*	invertebrate	species of conservation concern
Northern Mexican gartersnake	*Thamnophis eques megalops*	reptile	threatened
Pacific wren	*Troglodytes pacificus*	bird	species of conservation concern
Razorback sucker	*Xyrauuchen texanus*	fish	endangered
Richinbar talussnail	*Sonorella ashmuni*	invertebrate	species of conservation concern
Ripley wild buckwheat	*Eriogonum ripleyi*	plant	species of conservation concern
Roundtail chub	*Gila robusta*	fish	species of conservation concern
Salt River rock daisy	*Perityle gilensis var. salensis*	plant	species of conservation concern
Senator Mine alumroot	*Heuchera eastwoodiae*	plant	species of conservation concern
Sierra Ancha fleabane	*Erigeron anchana*	plant	species of conservation concern
Sonoran maiden fern	*Thelypteris puberula var. sonorensis*	plant	species of conservation concern
Southwestern willow flycatcher	*Empidonax traillii extimus*	bird	endangered
Spikedace	*Meda fulgida*	fish	endangered
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	bird	threatened
Verde Rim springsnail	*Pyrgulopsis glandulosa*	invertebrate	species of conservation concern
Yuma Ridgeway’s rail	*Rallus obsoletus yumanensis*	bird	endangered

Effects Common to All Alternatives

Management Areas Common to All Alternatives

Table 111. Effects of management areas to watershed and riparian conditions

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	Management for wilderness areas likely convey some benefits for riparian areas. Desired conditions focus on natural, functioning ecological process with an emphasis on minimal human disturbance. Developments, roads, and motorized uses that can have negative impacts on riparian areas are restricted in wilderness. Sites that show signs of disturbance are to have restrictions on use be rehabilitated. Generally, commercial activities are not permitted in wilderness, eliminating associated risks to riparian systems in these areas.
Designated Wild and Scenic Rivers	Fossil Creek and Verde River	Generally, plan direction for designated segments is thought to be beneficial for the riparian areas they include. The focus of such areas is to protect the outstandingly remarkable values for which they were designated, and these generally include plants and wildlife. Added direction regarding recreation activities, construction and roads in river corridors, vegetation and timber management, etc., all help to ensure healthy aquatic and riparian systems. One potential side-effect of designation may be an increased interest in recreation on designated segments, though this is difficult to quantify. Plan direction should help to mitigate such impacts.
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	These areas receive some additional guidance and protection through plan direction. Additional restrictions grazing, visitor use levels, logging, camping, fire suppression and management, and new roads, may offer some programmatic benefits to the riparian areas included in these areas.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(No significant effects expected)
Significant Caves	17 significant caves (see forest plan for more info)	(No significant effects expected)
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	Generally, plan direction for eligible segments is thought to be beneficial for the riparian areas they include. The focus of such areas is to protect the outstandingly remarkable values for which they are eligible, and these generally include plants and wildlife. Added direction regarding recreation activities, construction and roads in river corridors, vegetation and timber management, etc., all help to ensure healthy aquatic and riparian systems.

Type of area	Name(s)	Effects
Inventoried Roadless Areas	13 inventoried roadless areas	(No significant effects expected)
Management Area	Saguaro Wild Burro Management Area	(No significant effects expected)
Management Area	Apache Leap Special Management Area	(No significant effects expected)

Alternative A Effects

While direction in the current plan does address riparian vegetation, the heavy focus on structural type is less likely to achieve our current desired conditions that are more focused on ecological function, integrity, and dynamics. Overall, the scope of direction provided in the proposed action is more comprehensive and more likely to address the underlying issues affecting species.

There would be a low likelihood of making meaningful progress towards desired conditions with conditions remaining static, to slightly improved, within the next planning cycle under alternative A. This is largely due to the fact that plan direction under this alternative does not articulate where management is needed to achieve desired conditions – plan objectives are prescriptive cover class targets that do not focus management where conditions are most impaired (e.g., functioning-at-risk or non-functioning). Standards and guidelines direct management to maintain and restore degraded riparian conditions, but less so to manage for natural succession and diversity of riparian plant communities. Recommended research natural areas and management areas would afford some additional management emphasis and resource protection for rare and sensitive riparian areas, but for some of these areas management would be less effective at maintaining or enhancing riparian conditions (Blue Point Cottonwood and Sycamore Creek Natural Areas) because of changed conditions (loss of obligate wetland vegetation) and manageability (high recreation use and enforcement).

Management Areas: Alternative A

Table 112. Effects of management areas in alternative A to watershed and riparian conditions

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	These areas receive some additional guidance and protection through plan direction. Additional restrictions grazing, visitor use levels, logging, camping, fire suppression and management, and new roads, may offer some programmatic benefits to the riparian areas included in these areas.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A – 6K	(No significant effects expected)

Alternative B Effects

Direction for alternative B is similar to alternative C; however, alternative B strives to accommodate other uses (e.g., recreation, grazing, and mining) while alternative C proactively restricts uses that negatively impact. Thus, it is likely that alternative B would move towards desired more slowly than alternative C.

Alternatives B and C would likely result in improved riparian conditions and a positive trend towards desired conditions over the planning cycle more than alternatives A because plan direction clearly articulates where management is needed to achieve the desired conditions and plan objectives focus restoration efforts where riparian and stream channel conditions are most impaired (e.g., functioning-at-risk and non-functioning). Alternatives B and C would also provide improved management direction compared to alternative A – specifically by ensuring that activities and uses don't result in long-term degradation of riparian areas, setting appropriate limits for plant recovery following livestock use, and ensuring projects and activities are designed to promote a diversity of age classes and natural succession of riparian and wetland species. Therefore, alternatives B and C would provide better management direction aimed at improving riparian conditions and improving species diversity compared to alternative A. Alternative B and C would likely lead to more acres restored compared to alternative A due to better management direction and the greater number of objectives. Alternatives B and C would also increase the diversity (includes Sonoran desert riparian, rare spring ecosystem, rare wetland meadow, and canyon bottom mixed broadleaf riparian) of areas managed for their unique or rare status by incorporating three additional recommended botanical areas that contain rare and unique riparian ecosystems. While natural areas are not included in these alternatives, other areas (Arnett Creek within the recommended Picketpost Mountain Research Natural Area, recommended Mesquite Wash botanical area) would be better managed to maintain and protect rare Sonoran desert riparian areas. The main difference between alternative C and B is that alternative C has the potential to reach desired conditions at a faster rate – specifically at non-functioning riparian areas. However, implementing this standard has the potential to increase management conflicts and would require an increase in resources to accomplish the standard (relocating uses, fencing, monitoring).

Management Areas: Alternative B

Table 113. Effects of management areas in alternative B to watershed and riparian conditions

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	Generally, desired conditions for recommended wilderness focus on preserving natural ecologic processes and maintaining a relatively undisturbed system, which is likely to have some benefits for the watersheds and riparian areas they include. Restrictions on new roads, motorized access, and energy development, are likely to benefit the overall health and function of watershed and riparian areas.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	These areas receive some additional guidance and protection through plan direction. Additional restrictions grazing, visitor use levels, logging, camping, fire suppression and management, and new roads, may offer some programmatic benefits to the riparian areas included in these areas.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	These areas receive some additional guidance and protection through plan direction. Additional restrictions grazing, visitor use levels, logging, camping, fire suppression and management, and new roads, may offer some programmatic benefits to the riparian areas included in these areas.
Management Area	Lakes and Rivers Management Area	The effects of a heavy emphasis on recreation opportunity for aquatic, riparian, and watershed health are unclear. While much of the plan direction for this management area helps to mitigate potentially negative effects to habitat and species, the prioritization of recreation in this area is likely to result in long-term challenges for these systems. Much of the management area, such as the reservoirs and lower salt, is already heavily impact by recreational use and the riparian and aquatic systems function artificially; thus, management activities for the expected growth in use is unlikely to increase impacts that already exist.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, ongoing presence of horses is likely to degrade watershed and riparian condition by damaging vegetative ground cover, soils, stream banks, and riparian vegetation. Some wildlife may have to compete for forage and other resources.

Alternative C Effects

Effects are the same as alternative B, with additional effects described below; alternative C would include the following standard:

> If a riparian area is non-functioning, as identified in the Proper Functioning Condition Assessment framework or similar protocol, all permitted and allowed uses will be removed until riparian recovery is achieved.

This standard would exclude uses at riparian areas that are non-functioning. This standard would only apply to riparian areas that have the ability to reach their potential extent and where major stressors are within forest service jurisdiction. Plan direction for watersheds and riparian areas in this alternative are generally the same as the proposed action, alternative B; however, the focus on limiting or removing human disturbances suggest a longer-term solution for threats to species connected to these systems. If significant sources of disturbance are removed until desired conditions, this alternative is likely to convey the greatest benefit to species.

Management Areas: Alternative C

Table 114. Effects of management areas in alternative C to watershed and riparian conditions

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	Generally, desired conditions for recommended wilderness focus on preserving natural ecologic processes and maintaining a relatively undisturbed system, which is likely to have some benefits for the watersheds and riparian areas they include. Restrictions on new roads, motorized access, and energy development, are likely to benefit the overall health and function of watershed and riparian areas.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	These areas receive some additional guidance and protection through plan direction. Additional restrictions grazing, visitor use levels, logging, camping, fire suppression and management, and new roads, may offer some programmatic benefits to the riparian areas included in these areas.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	These areas receive some additional guidance and protection through plan direction. Additional restrictions grazing, visitor use levels, logging, camping, fire suppression and management, and new roads, may offer some programmatic benefits to the riparian areas included in these areas.

Type of area	Name(s)	Effects
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, ongoing presence of horses is likely to degrade watershed and riparian condition by damaging vegetative ground cover, soils, stream banks, and riparian vegetation. Some wildlife may have to compete for forage and other resources.

Alternative D Effects

This alternative has the least amount of direction specifying objectives and protections for watersheds and riparian areas. It also emphasizes access and allows for additional roads, both of which may have negative impacts on watershed and riparian areas. Generally, there are fewer restrictions to recreation and multiple uses that affect riparian areas.

While it does specify treating areas most at risk, the threats to watershed and riparian areas are large in scale and widespread, thus this alternative is the least likely to address threats to the many species tied to riparian and aquatic habitats.

Alternative D would likely lead to improved riparian conditions and a positive trend towards desired conditions over the planning cycle similar to alternative A. Alternatives B and C would likely result in more acres of riparian areas restored over the planning cycle compared to alternative D – mainly because those alternatives have objectives that set management priorities to accomplish restoration goals. Even though there are fewer objectives in alternative D, there would still be standards and guidelines (as described in alternative B) that would articulate the appropriate management to maintain and restore riparian conditions and species diversity – although management would likely maintain conditions more than actively restore conditions (less objectives). Alternative D would exclude all recommended research natural areas and recommended botanical areas. While these sensitive and rare ecosystems would still have riparian forestwide management direction, there is a potential that conditions may not be maintained as well as they could with the afforded resource protections and management emphasis that special areas would provide.

Management Areas: Alternative D

Table 115. Effects of management areas in alternative D to watershed and riparian conditions

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	None	(No significant effects expected)

Type of area	Name(s)	Effects
Management Area	Lakes and Rivers Management Area	The effects of a heavy emphasis on recreation opportunity for aquatic, riparian, and watershed health are unclear. While much of the plan direction for this management area helps to mitigate potentially negative effects to habitat and species, the prioritization of recreation in this area is likely to result in long-term challenges for these systems. Much of the management area, such as the reservoirs and lower salt, is already heavily impact by recreational use and the riparian and aquatic systems function artificially; thus, management activities for the expected growth in use is unlikely to increase impacts that already exist.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, ongoing presence of horses is likely to degrade watershed and riparian condition by damaging vegetative ground cover, soils, stream banks, and riparian vegetation. Some wildlife may have to compete for forage and other resources.

Summary and Comparison of Effects

Generally, alternatives C and B are considered very similar in their ability to provide ecological conditions needed by at-risk species. Because alternative C contains a standard to remove all permitted and allowed uses until recovery is achieved in riparian areas designated as non-functioning, it is possible that some of these areas would recovery at a faster rate than under alternative B; however, increased conflict is a likely outcome.

Alternative D provides the least amount of proactive restoration since there are fewer protective areas and mandates; however, it still contains much more direction to improve these areas.

Plan Components that Provide Ecological Conditions for At-risk Species

The following table describe threats to persistence associated with watershed and riparian conditions for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 116. Plan components that address threats to at-risk species related to poor watershed and riparian conditions

Threats to Persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
altered moisture regimes	Ancha mountainsnail, Arizona bugbane, broadleaf lupine, Davidson sage, Richinbar talussnail	ERU-MEW-DC-05; ERU-MCD-DC-05; ERU-PPF-DC-05; ERU-PPE-PG-DC-08; ERU-PPE-SS-DC-04; RERU-DC-09; RERU-DC-14; ERU-DC-13; WAT-DC-08; ERU-MCW-DC-02; ERU-MCW-DC-06	ERU-G-16
aquatic habitat departure	A mayfly, American dipper, broadleaf lupine, Chiricahua leopard frog, Colorado pikeminnow, desert pupfish, fossil springsnail, Gila chub, Gila topminnow, loach minnow, narrow-headed gartersnake, Northern Mexican gartersnake, Richinbar talussnail, roundtail chub, yellow-billed cuckoo, Yuma Ridgeway’s rail	See Watersheds and Water Resources (WAT)	See Watersheds and Water Resources (WAT)
flooding, sedimentation, and runoff	American dipper, Aravaipa sage, Arizona bugbane, Blumer's dock, broadleaf lupine, fossil springsnail, James' rubberweed, lowland leopard frog, Verde Rim springsnail	RMZ-DC-02; RMZ-DC-05; RMZ-DC-06; RERU-DC-10; RERU-DC-13; RERU-DC-15; RD-DC-06; WAT-DC-03; WAT-DC-04	REC-DIS-G-03; RD-G-08; RD-G-10
loss of prey base	Narrow-headed gartersnake	RERU-DC-10; ERU-DC-14; WFP-DC-01; WFP-DC-05; WFP-DC-07	INS-G-09; RMZ-G-03; RMZ-G-06; RMZ-G-08; WFP-G-08
loss of spring water	Fossil springsnail, marsh rosemary, Sonoran maiden fern, Verde Rim springsnail	RMZ-DC-01; RMZ-DC-08; WAT-DC-05; WAT-DC-08	FF-G-07; REC-DIS-NMO-G-02; RMZ-G-01; RMZ-O-02; RD-G-06; WAT-S-02; WAT-G-04
loss of streamside vegetation	Arizona giant sedge (syn. Cochise sedge), fossil springsnail	RERU-DC-01; RERU-DC-05; RERU-DC-06; RERU-DC-12; RERU-DC-16; RERU-DC-17; RERU-DC-18	RERU-G-01; RERU-G-02; RERU-G-04
more frequent or intense drought	Allen’s big-eared bat, A mayfly, Aravaipa sage, Arizona bugbane, Arizona hedgehog cactus, Blumer's dock, broadleaf lupine, broadleaf lupine, Chihuahuan sedge, Fish Creek fleabane, lowland leopard frog, marsh rosemary, Sierra Ancha fleabane, Sonoran desert tortoise, Sonoran maiden fern, southwestern willow flycatcher, western red bat	GRZ-DC-02; RERU-DC-10; RERU-DC-13; RERU-DC-15; WAT-DC-04	GRZ-G-03
poor watershed condition	Allen’s big-eared bat, Fish Creek fleabane, Gila chub, roundtail chub, western red bat	See Watersheds and Water Resources (WAT)	See Watersheds and Water Resources (WAT)

Threats to Persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
riparian habitat departure	Allen’s big-eared bat, Arizona bugbane, Arizona giant sedge (syn. Cochise sedge), Blumer's dock, broadleaf lupine, Chihuahuan sedge, fossil springsnail, marsh rosemary, monarch butterfly, narrow-headed gartersnake, net-winged midge, Northern Mexican gartersnake, roundtail chub, southwestern willow flycatcher, western red bat yellow-billed cuckoo, Yuma Ridgeway’s rail	See Riparian Areas, Seeps, Springs, Wetlands, and Riparian Management Zones (RMZ)	See Riparian Areas, Seeps, Springs, Wetlands, and Riparian Management Zones (RMZ)
streambank loss or instability	Fish Creek fleabane	RMZ-DC-02; RMZ-DC-05; RERU-DC-18	FP-S-01; LRMA-G-02; LRMA-G-03; RMZ-G-04; RD-G-07; RD-G-08; WAT-O-05
streamflow or channel alterations	American dipper, desert pupfish, loach minnow, lowland leopard frog, razorback sucker, Richinbar talussnail, roundtail chub, southwestern willow flycatcher, western red bat, yellow-billed cuckoo, Yuma Ridgeway’s rail	DWSRMA-DC-01; EWSRMA-DC-01; RMZ-DC-02; RMZ-DC-06; WAT-DC-03; WAT-DC-05; WAT-DC-08	EWSRMA-S-01; EWSRMA-S-03; MMAM-G-03; RMZ-G-06; RMZ-G-07; RD-G-06; RD-G-07; ERU-G-13; WAT-S-02; WAT-O-06; WAT-G-09
water developments	Blumer's dock, Chihuahuan sedge, Chiricahua leopard frog, Colorado pikeminnow, fossil springsnail, Gila rock daisy, Gila topminnow, Gila trout, loach minnow, mapleleaf false snapdragon, narrow-headed gartersnake, razorback sucker, Ripley wild buckwheat, roundtail chub, Salt River rock daisy, southwestern willow flycatcher, spikedace, yellow-billed cuckoo, Yuma Ridgeway’s rail	DWSRMA-DC-05	RMZ-G-03; RD-G-08; WAT-G-04; WAT-G-05; WAT-G-08; WAT-G-10; WFP-G-06; WFP-G-08; WFP-G-09
water withdrawal	A mayfly, American dipper, Arizona giant sedge (syn. Cochise sedge), Chiricahua leopard frog, Colorado pikeminnow, Davidson sage, desert pupfish, Gila chub, Gila topminnow, Gila trout, Hohokam agave, loach minnow, lowland leopard frog, narrow-headed gartersnake, Northern Mexican gartersnake, razorback sucker, roundtail chub, southwestern willow flycatcher, spikedace, Verde Rim springsnail, western red bat, Yuma Ridgeway’s rail	MMAM-DC-01; RMZ-DC-06; WAT-DC-01; WAT-DC-02; WAT-DC-05; WAT-DC-06; WAT-DC-08; WAT-DC-09	RMZ-G-01; WAT-S-02; WAT-S-03; WAT-O-06; WAT-G-06; WAT-G-07; WAT-G-09; WAT-G-10; WAT-G-14
wetland degradation	Broadleaf lupine, Chihuahuan sedge, Sonoran maiden fern, Yuma Ridgeway’s rail	REC-DIS-DC-01; RMZ-DC-01; WAT-DC-05; WAT-DC-08	REC-DIS-G-04; EG-G-03; FC-G-02; FF-G-04; FF-G-07; FP-S-01; FP-G-06; LRMA-G-03; GRZ-G-02; RERU-G-03; RD-G-06; WAT-S-02; WAT-G-04; WAT-G-08

Undesirable Fire Effects

Affected Environment

While fire is a natural and important process in a number of ecosystems on the forest, changes in the fire regime can pose significant challenges for at-risk species[8]. Uncharacteristic, high-intensity fire has the potential to directly impact species, especially rare or small populations. In other cases, species are impacted by subsequent changes to important habitats.

Frequent fire ecological response units are the most highly departed ecosystems on the Tonto National Forest. Historic logging practices, fragmentation through the construction of roads and trails and grazing with unintended consequences during the 19th and early 20th centuries have greatly reduced fine surface fuels (forbs and grasses) that typically carried frequent low-severity fire on the ground. These changes along with fire exclusion and suppression have contributed to higher densities of trees, increased fuel loadings, wildfire atypical of historic fire regimes, and altered species composition. As a result, many habitats that support species in these systems are highly stressed, are more prone to insect and disease outbreaks and experience higher severity fires (atypical fire regimes). The encroachment and/or increase of woody species produce fuel loadings that can act as ladder fuels, helping surface fire to climb into the canopy of tree crowns and resulting in increased occurrences of crown fire. Most frequent fire ecological response units have much longer fire return intervals, more acres in closed-canopy states, larger patch sizes and an excess of litter, duff, and coarse woody debris. Both, the ponderosa pine forest and mixed conifer-frequent fire ecological response units have coarse woody debris exceeding 40 tons per acre which can increase the loss of soils through intense heating from wildfires.

Fire is also a significant ecosystem characteristic for grassland (semi-desert grassland), and woodland (juniper grass, piñon-juniper grasslands) ecological response units because it removes litter, limits woody species germination and growth, and allows new lush grasses and shrubs to germinate and take advantage of the short-term release of nutrients in the ash. Today, without frequent fires, many semi-desert grassland sites resemble an atypical community (e.g., soft chaparral types) where soil-binding, perennial grasses have been replaced by shrubs and annuals (native and exotic) that compete with native grasses. Other negative impacts from altered fire regimes include loss of soil function (hydrophobic soils that repel water), erosion, severely burned soils that changes the chemical, physical and biological properties of the soil, the development of uncharacteristic plant communities (e.g., type conversions) and successional pathways – all of which ultimately threaten the viability of these ecosystems.

Table 117. At-risk species considered at risk of undesirable fire effects

Common Name	Scientific name	Taxonomic group	At-risk species status
American dipper	*Cinclus mexicanus*	bird	species of conservation concern
Ancha mountainsnail	*Oreohelix anchana*	invertebrate	species of conservation concern
Aravaipa sage	*Salvia amissa*	plant	species of conservation concern
Arizona bugbane	*Cimicifuga arizonica* (syn. *Actaea arizonica*)	plant	species of conservation concern
Arizona hedgehog cactus	*Echnocereus triglochidiatus* var. *arizonicus*	plant	endangered
Bezy’s night lizard	*Xantusia bezyi*	reptile	species of conservation concern

[8] A complete description of the existing condition of ecological response units on the Tonto National Forest, along with the analysis of the effects, by alternative, to these units can be found in the Ecological Response Units section of this environmental impact statement. The following analysis takes those conclusions as part of the basis for this analysis.

Common Name	Scientific name	Taxonomic group	At-risk species status
Blumer's dock	*Rumex orthoneurus*	plant	species of conservation concern
Broadleaf lupine	*Lupinus latifolius* ssp. *Leucanthus*	plant	species of conservation concern
Chiricahua leopard frog	*Echnocereus triglochidiatus* var. *arizonicus*	plant	endangered
Colorado pikeminnow	*Ptychocheilus lucius*	fish	endangered, experimental population, non-essential
Fish Creek rock daisy	*Perityle saxicola*	plant	species of conservation concern
Flagstaff Beardtongue	*Penstemon nudiflorus*	plant	species of conservation concern
Fossil springsnail	*Pyrgulopsis simplex*	invertebrate	species of conservation concern
Galiuro Talussnail	*Sonorella galiurensis*	invertebrate	species of conservation concern
Gila chub	*Gila intermedia*	fish	endangered
Gila rock daisy	*Perityle gilensis* var. *gilensis*	plant	species of conservation concern
Gila trout	*Oncorhynchus gilae*	fish	threatened
Gilded flicker	*Colaptes chrysoides*	bird	species of conservation concern
Grand Canyon century plant	*Agave phillipsiana*	plant	species of conservation concern
Hodgson's fleabane	*Erigeron hodgsoniae*	plant	species of conservation concern
Hohokam agave	*Agave murpheyi*	plant	species of conservation concern
James' rubberweed	*Hymenoxys jamesii*	plant	species of conservation concern
Loach minnow	*Tiaroga cobitis*	fish	endangered
Lowland leopard frog	*Lithobates yavapaiensis*	amphibian	species of conservation concern
Metcalfe's tick-trefoil	*Desmodium metcalfei*	plant	species of conservation concern
Mexican spotted owl	*Strix occidentalis lucida*	bird	threatened
Milk Ranch Talussnail	*Sonorella micromphala*	invertebrate	species of conservation concern
Mt. Dellenbaugh sandwort	*Eremogone aberrans syn. Arenarwia aberrans)*	plant	species of conservation concern
Narrow-headed gartersnake	*Thamnophis rufipunctatus*	reptile	threatened
Northern Mexican gartersnake	*Thamnophis eques megalops*	reptile	threatened
Pacific wren	*Troglodytes pacificus*	bird	species of conservation concern
Pringle's fleabane	*Erigeron pringlei*	plant	species of conservation concern
Razorback sucker	*Xyrauuchen texanus*	fish	endangered
Richinbar talussnail	*Sonorella ashmuni*	invertebrate	species of conservation concern
Roundtail chub	*Gila robusta*	fish	species of conservation concern
Salt River rock daisy	*Perityle gilensis* var. *salensis*	plant	species of conservation concern
Senator Mine alumroot	*Heuchera eastwoodiae*	plant	species of conservation concern
Sonoran desert tortoise	*Gopherus morafkai*	reptile	species of conservation concern
Southwestern willow flycatcher	*Empidonax traillii extimus*	bird	endangered
Sierra Ancha fleabane	*Erigeron anchana*	plant	species of conservation concern
Tonto Basin agave	*Agave delamateri*	plant	species of conservation concern

Common Name	Scientific name	Taxonomic group	At-risk species status
Verde Rim springsnail	*Pediomelum verdiensis*	plant	species of conservation concern
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	bird	threatened
Yellow-eyed junco	*Junco phaeonotus*	bird	species of conservation concern

Effects Common to All Alternatives

Management Areas Common to All Alternatives

Table 118. Effects of management areas on fire management.

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	Direction that prohibits motorized access and building of roads generally precludes the use of mechanical treatment and may ultimately increase the risk of undesirable fire effects to some at-risk. Conversely, the risk of unnatural ignitions is likely to decrease as these areas promote lower density recreation, restrict certain types of permitted activities, and remove motorized access.
Designated Wild and Scenic Rivers	Fossil Creek and Verde River	(No significant effects expected)
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	Fire is managed to mimic natural fire regimes and move towards desired conditions; guidelines call for strategic management and compatibility with the purpose of the area Directs the use of minimal impact suppression in order to protect resources.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(No significant effects expected)
Significant Caves	17 significant caves (see forest plan for more info)	(No significant effects expected)
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	(No significant effects expected)
Inventoried Roadless Areas	13 inventoried roadless areas	Direction that prohibits motorized access and building of roads may increase the risk of undesirable fire effects to some at-risk species because it limits treatment techniques to the use of fire. Conversely, the risk of unnatural ignitions is likely to decrease as these areas promote lower density recreation, be managed for primitive, semiprimitive nonmotorized, and semiprimitive motorized recreation opportunities.
Management Area	Saguaro Wild Burro Management Area	(No significant effects expected)

Type of area	Name(s)	Effects
Management Area	Apache Leap Special Management Area	(No significant effects expected)

Alternative A Effects

Management Areas: Alternative A

Table 119. Effects of management areas in alternative A on fire management

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	Fire is managed to mimic natural fire regimes and move towards desired conditions; guidelines call for strategic management and compatibility with the purpose of the area. Directs the use of minimal impact suppression in order to protect resources.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A – 6K	(No significant effects expected)

Alternative B Effects

This alternative proposes to use a combination of mechanical treatments, wildfire, and prescribed fire to restore fire to fire adapted systems and reduce the risk of undesirable fire effects to at-risk species. The flexibility to use various treatment tools is considered beneficial for at-risk species, since fire alone is more indiscriminate when working around sensitive plants, wildlife, habitats.

The overall acres in the objectives for this alternative are effectually the same as in alternative C, but are substantially larger the acres propose in alternative D. The proposed action also provides objectives for treating woodland ecological response units where fire is a risk for some species; however, the number of acres is substantially less than in alternative C.

Management Areas: Alternative B

Table 120. Effects of management areas in alternative B on fire management

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	Direction that prohibits building of new and temporary roads generally precludes the use of mechanical treatment and may ultimately increase the risk of undesirable fire effects to some at-risk. Conversely, the risk of unnatural ignitions is likely to decrease as these areas promote lower density recreation, restrict certain types of permitted activities, and remove motorized access.

Type of area	Name(s)	Effects
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Both proposed and designated botanical areas include specific restrictions on camping, campfires, and recreation shooting, reducing the risk of unnatural ignitions that could threaten at-risk species in these areas. Fire is managed to mimic natural fire regimes and move towards desired conditions; guidelines call for strategic management and compatibility with the purpose of the area. Directs the use of minimal impact suppression in order to protect resources.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Fire is managed to mimic natural fire regimes and move towards desired conditions; guidelines call for strategic management and compatibility with the purpose of the area. Directs the use of minimal impact suppression in order to protect resources.
Management Area	Lakes and Rivers Management Area	(No significant effects expected)
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, supplemental feeding of horses could result in the introduction of invasive species, as well as subsequent spread by horses, which could add to the risk of undesirable fire effects in the low deserts. Conversely, removal of ground forage could decrease ability of vegetation to carry fire. The specific outcomes are likely highly dependent on annual precipitation.

Alternative C Effects

The heavy emphasis of using wildland fire as the primary tool to restore frequent fire systems may result in reduced flexibly to treat in some situations. Managers may avoid treating some highly departed areas that pose added risks (e.g., very closed canopies with high risk of crown- fire). The use of wildland fire as a primary tool may increase the probability that some burns may developed into larger, harder to control fires, potentially putting some at-risk species at additional risk. The window of conditions for burning can be narrow; thus, some areas badly in need of treatment may remain at risk longer due to the focus on using fire are the primary tool to restore frequent-fire systems.

Management Areas: Alternative C

Table 121. Effects of management areas in alternative C on fire management

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	Direction that prohibits building of new and temporary roads generally precludes the use of mechanical treatment and may ultimately increase the risk of undesirable fire effects to some at-risk. Conversely, the risk of unnatural ignitions is likely to decrease as these areas promote lower density recreation, restrict certain types of permitted activities, and remove motorized access.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Both proposed and designated botanical areas include specific restrictions on camping, campfires, and recreation shooting, reducing the risk of unnatural ignitions that could threaten at-risk species in these areas. Fire is managed to mimic natural fire regimes and move towards desired conditions; guidelines call for strategic management and compatibility with the purpose of the area. Directs the use of minimal impact suppression in order to protect resources.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Fire is managed to mimic natural fire regimes and move towards desired conditions; guidelines call for strategic management and compatibility with the purpose of the area. Directs the use of minimal impact suppression in order to protect resources.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, supplemental feeding of horses could result in the introduction of invasive species, as well as subsequent spread by horses, which could add to the risk of undesirable fire effects in the low deserts. Conversely, removal of ground forage could decrease ability of vegetation to carry fire. The specific outcomes are likely highly dependent on annual precipitation.

Alternative D Effects

Due to the expense of relying primarily on mechanical treatments for restoring frequent fire systems, the direction in this alternative is likely to treat the fewest acres in the action alternatives. Repeated entry of machinery in treated areas may also have greater short-term impacts on soils and vegetation compared to alternatives where prescribed burns are used to follow initial mechanical treatments.

This alternative does not include any objectives to treat woodland ecological response units since treatments are prioritized in frequent-fire forests and forest products are emphasized. As such, species in these systems may remain at greater risk of undesirable fire effects.

Management Areas: Alternative D

Table 122. Effects of management areas in alternative D on fire management

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	None	(No significant effects expected)
Management Area	Lakes and Rivers Management Area	(No significant effects expected)
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, supplemental feeding of horses could result in the introduction of invasive species, as well as subsequent spread by horses, which could add to the risk of undesirable fire effects in the low deserts. Conversely, removal of ground forage could decrease ability of vegetation to carry fire. The specific outcomes are likely highly dependent on annual precipitation.

Summary and Comparison of Effects

Of the four alternatives being considered for this project, alternative B is has the great potential for positively addressing fire concerns, as described in this section.

Plan Components that Provide Ecological Conditions for At-risk Species

The following table describe threats to persistence associated with undesirable fire effects for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 123. Plan components that address threats to at-risk species related to undesirable fire effects

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
departed fire regime	Bezy’s night lizard, Blumer's dock, fringed myotis, Gila rock daisy	ERU-IC-DC-02; ERU-MEW-DC-05; ERU-MEW-DC-06; ERU-MCD-DC-05; ERU-MCD-DC-07; ERU-PJC-DC-03; ERU-PJJUG-DC-02; ERU-PJO-DC-02; ERU-PPF-DC-03; ERU-PPF-DC-05; ERU-PPE-PG-DC-07; ERU-PPE-PG-DC-10; ERU-PPE-SS-DC-03; ERU-PPE-SS-DC-05; ERU-DC-06; ERU-DC-07; ERU-DC-13; ERU-DC-19; ERU-DC-25; ERU-MCW-DC-02; ERU-MCW-DC-07	RNBAMA-G-01; FF-S-04
fire suppression activities	Colorado pikeminnow, fossil springsnail, loach minnow, razorback sucker, roundtail chub, spikedace	FF-DC-02; FF-DC-04	FF-G-03; FF-G-04; FF-G-06; FF-G-8; FF-G-09; FF-G-10
high fuel loads	Aravaipa sage, Arizona bugbane, Blumer's dock, broadleaf lupine, Hodgson's fleabane	FF-DC-02; FF-DC-04; FF-DC-05; FF-DC-07; ERU-DC-22; ERU-DC-24	FF-S-04; FF-G-05; FF-G-07; ERU-G-17
uncharacteristic fire in low desert systems	Gila rock daisy, Grand Canyon century plant, Hohokam agave, Sonoran desert tortoise, Tonto Basin agave	ERU-DES-DC-03; ERU-DES-DC-04; ERU-IC-DC-02; ERU-SDG-DC-03; ERU-SDG-DC-05	NA
uncharacteristic, high-intensity fire	Allen’s big-eared bat, American dipper, Ancha mountainsnail, Aravaipa sage, Arizona bugbane, Arizona hedgehog cactus, Bezy’s night lizard, Blumer's dock, broadleaf lupine, Chiricahua leopard frog, Colorado pikeminnow, Fish Creek rock daisy, Flagstaff Beardtongue, fossil springsnail, Gila chub, Gila rock daisy, Gila trout, Gilded flicker, Hodgson's fleabane, James' rubberweed, loach minnow, lowland leopard frog, Metcalfe's tick-trefoil, Mexican spotted owl, Milk Ranch Talussnail, Mt. Dellenbaugh sandwort, narrow-headed gartersnake, Northern Mexican gartersnake, Pacific wren, Pringle's fleabane, razorback sucker, Richinbar talussnail, roundtail chub, Salt River rock daisy, Senator Mine alumroot, Sierra Ancha fleabane, southwestern willow flycatcher, spikedace, Tonto Basin agave, Verde Rim springsnail, western red bat, yellow-billed cuckoo, yellow-eyed junco	ERU-DES-DC-04; ERU-IC-DC-02; ERU-SDG-DC-05; ERU-DC-01; ERU-DC-05; ERU-DC-19; ERU-MCW-DC-02; ERU-MCW-DC-02	FF-S-01; FF-G-07; FF-G-11

Environmental Effects: Threats to Species (Fine-filter)

Disturbance from Vegetation and Timber Management Activities

Affected Environment

While the forest consists of approximately 302,436 acres of timberland, about half is considered unsuitable for timber production, and other areas have been designated as wilderness areas[9]. Only 109,492 acres of the forest (4 percent of the total land area) is considered suitable as a timber base in the current 1985 forest plan.

Until recently, the Forest's primary contribution of timber and forest products was fuelwood to local communities, but recent emphasis on fuel reduction and forest restoration has increased commercial timber harvest to rates that now exceed that of fuelwood. This increased emphasis in land restoration projects should allow the continued ability to contribute to both timber and fuelwood demands. An increase in forest restoration projects will be vital to help sustain forest and watershed health, prevent uncharacteristic wildfire, and improve or maintain wildlife habitat, and contribute to local economies. Christmas trees and plants collected for ceremonial use are a few examples of forest products the forest provides.

Table 124. At-risk species associated with disturbance from vegetation and timber management activities

Common Name	Scientific name	Taxonomic group	At-risk species status
Colorado pikeminnow	*Ptychocheilus lucius*	fish	endangered, experimental population, non-essential
Fossil springsnail	*Pyrgulopsis simplex*	invertebrate	species of conservation concern
Loach minnow	*Tiaroga cobitis*	fish	endangered
Mexican spotted owl	*Strix occidentalis lucida*	bird	threatened
Milk Ranch Talussnail	*Sonorella micromphala*	invertebrate	species of conservation concern
Razorback sucker	*Xyrauuchen texanus*	fish	endangered
Richinbar talussnail	*Sonorella ashmuni*	invertebrate	species of conservation concern
Roundtail chub	*Gila robusta*	fish	species of conservation concern
Sierra Ancha talussnail	*Sonorella anchana*	invertebrate	species of conservation concern
Spikedace	*Meda fulgida*	fish	endangered

Effects Common to All Alternatives

Under all alternatives, vegetation management is one of the key restoration tools used to achieve long-term desired conditions in many systems. As a result, species and habitats may experience short-term negative effects associated with the various practices. Direct and indirect effects of vegetation management may include direct mortality/disturbance, soil compaction, increased sedimentation post-treatment, noise, and increased road densities.

All of the species in this analysis considered at risk from negative impacts of vegetation and timber management are also at risk of undesirable fire effects resulting from departed habitats and fire regimes.

[9] A complete description of the existing condition of vegetation management on the Tonto National Forest, along with the analysis of the effects, by alternative, can be found in the Ecological Response Units section of this environmental impact statement. Information about the existing condition of timber management on the Tonto National Forest, along with the analysis of the effects, by alternative, can be found in the Forestry and Forest Products section of this environmental impact statement. The following analysis takes those conclusions as part of the basis for this analysis.

(Lee 2005, Lee 2012, Ganey 2017). Thus, while there is a potential for negative short-term effects during vegetation and timber management; overall, such work is vitally important for the long-term persistence of these same species. This is especially the case for small populations and very rare species in which mechanical treatments are likely to afford more site-specific mitigations that use of wildfire or prescribed burning alone.

As such, in this analysis we do not consider more acres treated as necessarily conveying a greater threat to species that may be sensitive to vegetation and timber management, but instead we will consider the level of protection offered in plan components to at-risk and other species between alternatives.

In general, direction addressing this threat to at-risk and other species does not vary across action alternatives. Additional plan components that mitigate negative impacts of vegetation management are described below (see also appendix G in volume 4).

Management Areas Common to All Alternatives

Table 125. Effects of management areas on vegetation and timber management

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	The Wilderness Act prohibits permanent roads and the use of any form of motorized transport within wilderness area; thus, species at risk of effects from vegetation and timber management would not be exposed to effects from roads, mechanical equipment, soil compaction, or other mechanized impacts. All effects would be limited to vegetation treatments related to fire.
Designated Wild and Scenic Rivers	Fossil Creek and Verde River	(no significant effect expected)
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	Logging is not permitted in these research natural areas unless required for restoration, offering some protection for species that may be negatively impacted by these activities. Generally, the majority of vegetation and timber treatments on the forest are related to restoration activities, thus the initial risk to species by commercial and private logging is fairly low.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(No significant effects expected)
Significant Caves	17 significant caves (see forest plan for more info)	(No significant effects expected)
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	(No significant effects expected)
Inventoried Roadless Areas	13 inventoried roadless areas	Timber cannot be cut, sold, or removed in these areas, thus threats from these types of activities are greatly reduced in these roadless areas.
Management Area	Saguaro Wild Burro Management Area	(No significant effects expected)

Type of area	Name(s)	Effects
Management Area	Apache Leap Special Management Area	(No significant effects expected)

Alternative A Effects

The Tonto National Forest's 1985 plan does contain plan components that seek to minimize impacts from timber and vegetation treatments to wildlife; however, these tend to be limited in many ways to mitigations specifically for just a few species, namely northern goshawks and Mexican spotted owls. While the plan direct likely has benefits for these species, there are fewer plan components specifying generic mitigations and practices that would benefit additional at-risk species affected by these activities. There are plan components guiding to managers to consider habitats of the regional forester's sensitive species generally, but the lack of a specific connection to impacts from vegetation and timber management make it more challenging to require mitigations during these projects. More specific mitigation standards and guidelines are more likely to result in protections for species at the project level

Because much of the direction regarding the role of vegetation management in conserving at-risk species is vague, alternative A relies primarily on law, regulation, and policy outside of the forest plan to protect and mitigate effects on species from vegetation and timber treatments. While, this is likely sufficient in many cases, it does not clearly fulfill the role of including plan components that provide the ecological conditions necessary for the long-term persistence of species that may be impacted by vegetation and timber uses.

Management Areas: Alternative A

Table 126. Effects of management areas in alternative A on vegetation and timber management.

Type of area	Name(s)	Effects
Recommended Wilderness	None	No significant effects expected
Proposed Botanical Areas	None	No significant effects expected
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	Logging is not permitted in these research natural areas unless required for restoration, offering some protection for species that may be negatively impacted by these activities. Generally, the majority of vegetation and timber treatments on the forest are related to restoration activities, thus the initial risk to species by commercial and private logging is fairly low.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A – 6K	No significant effects expected

Effects Common to Alternatives B, C, D

For many of the species considered here, the primary threat associated with vegetation and timber management is a result of even-aged management techniques. Plan direction for all action alternatives specifies that even-aged timber harvest only be use where an environmental analysis deems it appropriate, based on environmental criteria that include species habitat needs. There are numerous standards and guidelines that constrain even-aged timber harvest in order to provide for species needs:

- FP-S-05: Even-aged timber harvest methods shall be used only where a completed interdisciplinary team review (and environmental analysis) determines them to be appropriate, and the removal of the majority of overstory vegetation will only be used where it is determined to be the optimum method.
- FP-S-07: Even-aged harvest shall only be used where determined to be appropriate based on project specific conditions and the desired conditions for vegetation, wildlife habitat, scenery and other resources. Maximum size of openings that may be created in one harvest operation will be limited to 40 acres or less, unless specific conditions require larger openings (e.g., forest health, meadow restoration, or achieving other desired ecological conditions). Specific projects in which an interdisciplinary review indicate that a larger opening is required will require Regional Forester approval on a case by case basis.
- ERU-G-08: Even-aged silvicultural practices may be used as a strategy for achieving the desired conditions over the long term, such as bringing mistletoe infection levels to within a sustainable range. Treatments should mimic desired conditions for patch sizes. Treatments for mitigating adverse impacts should not completely eliminate mistletoe but, rather, they should typically be aimed at reducing infection levels across the stand and increasing host vigor.
- ERU-PPF-DC-01: The ponderosa pine forest vegetation community is composed of trees from structural stages ranging from young to old. Forest appearance is variable but generally uneven-aged and open; occasional areas of even-aged structure are present. The forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably-sized openings of grass/forbs/shrubs vegetation associations similar to historic patterns. Size, shape, number of trees per group, and number of groups per area are variable across the landscape. In the Gambel oak sub-type, all sizes and ages of oak trees are present. Denser tree conditions exist in some locations such as north facing slopes and canyon bottoms.

Because vegetation and timber projects often make use of heavy machinery, at-risk species and habitats may experience short-term, negative impacts. All action alternatives provide guidance to protect sensitive habitats, including aquatic and riparian areas.

- FP-G-06: Log landing areas should be located outside of sensitive areas (e.g., riparian areas, wetlands and natural meadows, archeological sites, karst formations, sensitive species areas, and along Scenery Management System Concern Level I roads). When landings must be located in these areas, effects to the sensitive resource should be mitigated.
- RERU-G-01: Vegetation management (e.g., timber harvest, invasive species, and prescribed fire) should not result in long-term degradation to riparian ecological response units.
- FP-S-01: Timber harvest and vegetation manipulation shall only occur where soil, slope, and watersheds will not be irreversibly damaged, and protection must be provided for streams, streambanks, riparian, shorelines, lakes, wetlands, other waterbodies, fish, wildlife, recreation, cave and karst formations, cultural, and aesthetic resources.

For a number of wildlife species, snags (i.e., dead and dying trees) and large diameter trees provide important habitat elements. The action alternatives contain plan content that directs vegetation management to retain snags and consider their importance for wildlife and ecosystem function. Additionally, plan components instruct managers to use masticated materials and downed logs to improve vegetation and riparian conditions:

- ERU-G-09: Vegetation management activities should retain large diameter trees, snags, and downed logs in and near stream channels (where appropriate) and riparian areas to provide for wildlife habitat and recruitment of large woody material.

- FP-G-05: Timber harvest and mechanical fuels treatments should be designed to develop or manage vegetation and coarse woody debris within the range of the desired conditions (e.g., snags, large woody debris). If these attributes were not present in the stand before the activity, treatments should be designed to help meet those requirements in the future.
- ERU-G-04: In areas within woodland and forested ecological response units where there is little understory and mechanical treatments are proposed, slash treatments (e.g., lop and scatter and mastication) should be used to improve herbaceous vegetation growth, watershed condition, soil productivity, and minimize long-term impacts from invasive species. Desired fire behavior and severity, burn severity, firefighter safety, and livestock movement should inform any decision to leave slash on site.
- ERU-PPF-G-01: Management activities should leave an average of 1 to 2 snags greater than 18 inches per acre, when these components exist on the landscape prior to treatment.

Generally, management focuses on using commercial and private timber harvest in order to restore forested systems and achieve desired conditions, specifically mentioning habitat needs of species. Direction for vegetation and timber management mandate sustainable practices that allow adequate regeneration.

- FP-DC-02: Personal and commercial timber harvest supplement other restoration and maintenance treatments in forested vegetation communities at a scale that achieves and maintains landscape desired conditions over time.
- FP-DC-05: Harvest of dead and dying trees balance economic value with the needs of wildlife habitat, soil productivity, and ecosystem functions.
- FP-S-04: When openings are created with the intent of regeneration, efforts shall be made to ensure that lands can be adequately restocked within 5 years of final harvest.
- FP-S-08: The quantity of timber that may be sold is limited to an amount equal to or less than that which can be removed from such forest annually in perpetuity on a sustained yield basis, unless the departure is justified and approved in accordance with direction found in FSH 1909.12, Chapter 60, section 64.33. This limit may be measured on a decadal basis.

Plan direction in the Wildlife, Fish, and Rare Plants chapter specify considerations for sensitive life history processes (e.g., reproduction, molting, migration, and hibernation) and provides example strategies to protect species from threats that would include vegetation and timber management.

- WFP-G-04: Projects and activities that may negatively impact at-risk species should consider protections and design elements to address impacts, especially considering the timing and location of vulnerable life history processes (e.g., reproduction, molting, migration, and hibernation). Examples of design elements and protections could include but are not limited to timing restrictions, adaptive percent utilization levels, distance buffers.

Direction in all action alternatives for forestry and forest products acknowledges habitat needs of species and seeks to mitigate negative impacts. The guidance provided in all action alternatives for Forestry and Forest products helps to diffuse threats to at-risk species while contributing to important desired conditions that enhance wildlife habitat. The majority of proposed plan content for vegetation does not change appreciably between these alternatives.

For a crosswalk showing how plan components address species-specific threats related to these activities, see appendix G.

Alternative B Effects

- Alternative B proposes as an objective to treat 50,000–122,000 acres over a 10-year period through mechanical thinning followed by prescribed burning and 105,000 –325,000 acres over a 10-year period using wildfire and prescribed fire in forested ecological response units.
- In woodland ecological response units, alternative B proposes to treat 400–2,000 acres over a 10-year period through mechanical thinning followed by prescribed burning and 20,000–200,000 acres over a 10-year period using wildfire and prescribed fire.
- The objectives for treatments in this alternative are functionally very similar to those proposed in alternative C (B proposes 2,000 additional acres than C); however, this alternative would expose species to substantially more vegetative and timber treatments (195,000 acres) than in alternative D.

Management Areas: Alternative B

Table 127. Effects of management areas in alternative B on vegetation and timber management

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	Similar to designated roads, direction for recommended wilderness generally precludes the use of new permanent or temporary roads; thus, species at risk of effects from vegetation and timber management would not be exposed to effects from roads, mechanical equipment, soil compaction, or other mechanized impacts. All effects would be limited to vegetation treatments related to fire.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Logging is not permitted in botanical areas unless required for restoration, offering some protection for species that may be negatively impacted by these activities. Generally, the majority of vegetation and timber treatments on the forest are related to restoration activities, thus the initial risk to species by commercial and private logging is fairly low.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Logging is not permitted in these research natural areas unless required for restoration, offering some protection for species that may be negatively impacted by these activities. Generally, the majority of vegetation and timber treatments on the forest are related to restoration activities, thus the initial risk to species by commercial and private logging is fairly low.
Management Area	Lakes and Rivers Management Area	(no significant effect expected)
Management Area	Salt River Horse Management Area	(no significant effect expected)

Alternative C Effects

Alternative C proposes as an objective to treat 11,000-22,000 acres over a 10-year period through mechanical thinning followed by prescribed burning and 144,000-423,000 acres over a 10-year period using wildfire and prescribed fire. In woodland ecological response units, alternative C proposes to treat 230,000-410,000 acres over a 10-year period using wildfire and prescribed fire. The objectives for treatments in this alternative are functionally very similar to those proposed in alternative B; however, this alternative would expose species to substantially more vegetative and timber treatments than in alternative D.

Management Areas: Alternative C

Table 128. Effects of management areas in alternative C on vegetation and timber management

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	Similar to designated roads, direction for recommended wilderness generally precludes the use of new permanent or temporary roads; thus, species at risk of effects from vegetation and timber management would not be exposed to effects from roads, mechanical equipment, soil compaction, or other mechanized impacts. All effects would be limited to vegetation treatments related to fire.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Logging is not permitted in botanical areas unless required for restoration, offering some protection for species that may be negatively impacted by these activities. Generally, the majority of vegetation and timber treatments on the forest are related to restoration activities, thus the initial risk to species by commercial and private logging is fairly low.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Logging is not permitted in these research natural areas unless required for restoration, offering some protection for species that may be negatively impacted by these activities. Generally, the majority of vegetation and timber treatments on the forest are related to restoration activities, thus the initial risk to species by commercial and private logging is fairly low.
Management Area	Salt River Horse Management Area	(no significant effect expected)

Alternative D Effects

This alternative proposes to treat 50,000-190,000 acres over a 10-year period through mechanical thinning followed by prescribed burning and 16,000-62,000 acres over a 10-year period using wildfire and prescribed fire; there are no objectives for woodland ecological response units. This is the fewest number of acres for each 10-year period for both mechanical and fire methods. Because there are fewer treatments, the risk of negative effects from treatments would logically decrease as well.

Management Areas: Alternative D

Table 129. Effects of management areas in alternative D on vegetation and timber management.

Type of Area	Name(s)	Effects
Recommended Wilderness	None	No significant effect expected
Proposed Botanical Areas	None	No significant effect expected
Proposed Research Natural Areas	None	No significant effect expected
Management Area	Lakes and Rivers Management Area	No significant effect expected
Management Area	Salt River Horse Management Area	(No significant effect expected)

Summary and Comparison of Effects

Generally speaking, alternatives C and D are mostly likely to reduce the levels of vegetation and timber management across the forest. In the case of alternative D, this is due to objectives for lower levels of treatments overall. While fewer treatments may lower the chance of disturbance, this alternative emphasizes mechanical methods over prescribed burning, which may have more impacts to at-risk species that fire methods. With this in mind, alternative C reduces the levels of vegetation and timber management through the proposal of additional management areas in which these activities are likely to be constrained. Additionally, while alternatives B and D have relatively similar levels of proposed mechanical treatments, C plans substantially fewer of these treatments which may also lessen the risk of impact.

Whereas most of the analyses in this report assume that plan alternatives that reduce the overall impact of a threat to at-risk species is likely to contribute to long-term persistence, the case of vegetation and timber treatments is an important deviation. All species identified as at risk of negative impacts from vegetation and timber activities are also considered at-risk from undesirable fire effects. Uncharacteristic fire effects are generally considered the primary threat to frequent fire systems and a substantial threat to desert and riparian systems as well. Because vegetation and timber management (both mechanical and prescribed fire) are considered important tools in restoring ecosystem integrity and diversity in these systems, reducing these activities may actually increase the overall risk to persistence for at-risk species. Because of this inverse relationship, we consider plan direction that seeks to mitigate the impacts of vegetation and timber treatment to be the most important component of providing ecological conditions for species at risk from these projects.

Ultimately, all action alternatives contain direction that addresses potential effects from vegetation and timber treatments, contributing to the long-term persistence and recovery of at-risk species.

Components that Provide Ecological Conditions for At-risk Species

Table 130. Plan components that address threats to at-risk species related to disturbance from vegetation and timber management activities

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
vegetation and timber management	Colorado pikeminnow, fossil springsnail, loach minnow, Mexican spotted owl, Milk Ranch talussnail, razorback sucker, Richinbar talussnail, roundtail chub, Sierra Ancha talussnail, spikedace	FP-DC-01; FP-DC-02; FP-DC-05	FP-S-01; FP-G-01; FP-S-02; FP-G-03; FP-S-04; FP-G-04; FP-G-06; FP-S-08; FP-S-09

Invasive Species, Disease, and Other Pathogens

Affected Environment

Nonnative, invasive species are present throughout the Tonto National Forest and pose a large challenge in conserving native species[10]. While present in most ecosystems on the forest, riparian, aquatic, and low desert systems have been particularly affected. Many permitted and allowed uses on the forest are potential vectors for invasive species (e.g., off-road vehicles, timber management, roads and trails, boats, etc.).

Invasive species are currently treated under the Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants Tonto National Forest: Gila, Maricopa, Pinal, and Yavapai Counties, Arizona (USDA Forest Service 2012b), which outlines the methods and mitigations that can be used. Other projects for aquatic invasive species, including education and prevention, are conducted in partnership with Arizona Game and Fish Department.

Table 131. At-risk species that may be negatively impacted by invasive species, insects, disease, and other pathogens

Common Name	Scientific name	Taxonomic group	At-risk species status
A mayfly	*Fallceon eatoni*	invertebrate	species of conservation concern
American dipper	*Cinclus mexicanus*	bird	species of conservation concern
Blumer's dock	*Rumex orthoneurus*	plant	species of conservation concern
Broadleaf lupine	*Lupinus latifolius* ssp. *Leucanthus*	plant	species of conservation concern
Chihuahuan sedge	*Carex chihuahuensis*	plant	species of conservation concern
Chiricahua leopard frog	*Lithobates chiricahuensis*	amphibian	threatened
Colorado pikeminnow	*Ptychocheilus lucius*	fish	endangered, experimental population, non-essential
Desert pupfish	*Cyprindon macularius*	fish	endangered
Fish Creek rock daisy	*Perityle saxicola*	plant	species of conservation concern
Gila chub	*Gila intermedia*	fish	endangered

[10] A complete description of the existing condition of invasive species on the Tonto National Forest, along with the analysis of the effects, by alternative, can be found in the Invasive Species section following this Wildlife, Fish, and Plants section. The following analysis takes those conclusions as part of the basis for this analysis.

Common Name	Scientific name	Taxonomic group	At-risk species status
Gila topminnow	*Poeciliopsis occidentalis*	fish	endangered
Gila trout	*Oncorhynchus gilae*	fish	threatened
Grand Canyon century plant	*Agave phillipsiana*	plant	species of conservation concern
Hohokam agave	*Agave murpheyi*	plant	species of conservation concern
Loach minnow	*Tiaroga cobitis*	fish	endangered
Lowland leopard frog	*Lithobates yavapaiensis*	amphibian	species of conservation concern
Mexican spotted owl	*Strix occidentalis lucida*	bird	threatened
Narrow-headed gartersnake	*Thamnophis rufipunctatus*	reptile	threatened
Northern Mexican gartersnake	*Thamnophis eques megalops*	reptile	threatened
Razorback sucker	*Xyrauuchen texanus*	fish	endangered
Roundtail chub	*Gila robusta*	fish	species of conservation concern
Sonoran desert tortoise	*Gopherus morafkai*	reptile	species of conservation concern
Southwestern willow flycatcher	*Empidonax traillii extimus*	bird	endangered
Spikedace	*Meda fulgida*	fish	endangered
Tonto Basin agave	*Agave delamateri*	plant	species of conservation concern
Verde Rim springsnail	*Pyrgulopsis glandulosa*	invertebrate	species of conservation concern
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	bird	threatened

Effects Common to All Alternatives

Invasive species, disease, and other pathogens pose a substantial threat to biodiversity on the Tonto National Forest in terrestrial, aquatic, and riparian ecosystems. Invasive, nonnative species can negatively impact some native species in various ways, including direct competition, displacement, predation, spreading of disease, and introgressive hybridization. They can influence and significantly disrupt the composition and structure of ecosystems as well as natural processes including fire return intervals, soil stability, and ecosystem hydrology.

In aquatic habitats on the Tonto National Forest, nonnative sportfish have been introduced broadly and are managed in constructed waters and high use streams by Arizona Game and Fish Department. While enhancing recreational user's experiences in some areas, throughout the Tonto National Forest nonnative fish threaten native species. Bullfrogs and other nonnative invertebrates, such as Quagga mussel, crayfish, and apple snails, are also known to impact aquatic systems.

In desert ecosystems, the proliferation of nonnative, invasive grasses poses the greatest threat to native plant communities. Nonnative grasses that invade desert areas increase the potential to carry fire in ecosystems that evolved largely without fire. After burning, these grasses further invade burned areas increasing fire return-intervals, creating a positive feedback loop in which native species may be displaced. Native grasses can also lower site productivity and may not be as effective in preventing erosion. These shifts may ultimately lead to lower biodiversity and threaten at-risk species.

Diseases and other pathogens brought from outside the forest also threaten native species. Chytrid fungus has been found on the forest and it is deadly to amphibians. White-nose syndrome has killed millions of bats and although it has not been reported on the forest, it is expected to move to the southwest in the near future.

Alternative A Effects

The 1985 plan (alternative A) does not address invasive species, although law, regulations, and policy guides current management to contain, control, and eradicate invasive species. Due to these outside regulations, we expect that current conditions would continue to be maintained under alternative A; however, movement towards desired conditions would likely occur at a slower rate compared to the action alternatives that include specific plan components addressing this important ecologic issue.

The current rate of spread of existing invasive species and the current rate of introduction of new invasive species would continue. The same is likely to be true of other invasive animal species. This alternative provides for the highest rate of access to the highest portion of acres on the forest by not establishing new wilderness areas or making additions to existing wilderness areas.

Currently the Tonto National Forest utilizes the Environmental Assessment for Integrated Treatment of Noxious and Invasive Plants (2012b) document for treatment of current invasive species management on the forest. By continuing current management under the existing forest plan, all of the available options for invasive species survey and treatment would continue. While there are restrictions in treating invasive species inside the areas proposed for wilderness in the other alternatives, invasive species treatment by current approved forest methodologies would remain as an option if an infestation was detected.

Projects addressing invasive wildlife species would continue to be conducted in collaboration with Arizona Game and Fish department; however, there are no specific plan components that direct these projects.

Management Areas: Alternative A

Table 132. Effects of management areas in alternative A on invasive species and other pathogens

Type of area	Name(s)	Effects
Recommended Wilderness	None	No significant effects expected
Proposed Botanical Areas	None	No significant effects expected
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	Specific direction for management activities and permitted/allowed uses is likely to help reduce vectors of invasive species and other pathogens. Desired conditions for botanical areas are likely to lead to projects that decisions that work to protect these areas from invasive species and other pathogens.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A – 6K	No significant effects expected

Effects Common to Alternatives B, C, D

While many forest uses contribute to the spread or introduction of invasive species, diseases, and other pathogens, the proposed forest plan (all action alternatives) addresses this threat in many program areas.

Desired conditions for forest ecosystems that are not substantially impacted by invasive, nonnative species:

- INS-DC-01: Invasive species do not disrupt ecological functionality, affect the sustainability of native species, cause economic harm, or negatively impact human health.
- ERU-DC-10: Ecosystem function is supported by native plant communities and have little or no invasive species. If invasive or exotic species are present, they are not detrimental to natural diversity, or ecosystem function for any ecological response unit.

The plan also calls for treating invasive species, including specific objectives:

- ERU-O-04: Survey, inventory, or treat 10,000 to 15,000 acres of invasive species (e.g., buffelgrass, fountain grass, and red brome) in desert ecological response units (Sonoran Desert plant communities and Sonora-Mojave mixed-salt desert scrub) over a 10-year period.
- INS-O-01: Treat and control invasive species on 200-1,500 acres should occur on annually.
- ERU-G-03: Ground-disturbing activities that increase the risk of invasion by exotic and invasive plant species should include measures to eradicate or limit the spread of these species before, during and/or following the activity and implement measures to limit the potential for spread into unoccupied areas.

The proposed direction in all action alternatives specifies measures to prevent or reduce the spread of invasive species, disease, and other pathogens:

- WAT-S-04: Activities in and around surface waters will use decontamination procedures that prevent the spread of detrimental parasites, pathogens (e.g., fungi, bacteria, protozoa), and invasive species.
- RMZ-G-02: Projects affecting perennial streams should be designed and constructed to allow for natural instream movement of aquatic species, except where barriers are necessary to preclude the movement of nonnative species.
- INS-G-06: When drafting water from streams or other water bodies, measures should be taken to prevent the spread of parasites, pathogens (e.g., fungi, bacteria, protozoa), and invasive species.
- GRZ-G-06: Efforts (e.g., coordination with permittees, temporary fencing, increased herding, and herding dogs) should be made to prevent transfer of disease from domestic sheep and goats to bighorn sheep wherever bighorn sheep occur. Allotment conversions from cattle to domestic sheep or goats should not be allowed in areas adjacent to or inhabited by bighorn sheep.

The proposed action also provides guidance for restoration efforts that promote native species and reduce the potential for nonnative invasions:

- ERU-G-02: For restoration, seeding with native species appropriate for the area (or similar in elevation, soil type, and ecosystem) should be prioritized. Use of desirable, nonnative weed free plant materials may be allowed where native plant materials are unavailable, cost-prohibitive, insufficient to address site-specific problems, and the nonnative plant materials do not impede re-establishment of native species or degrade ecological integrity.
- INS-G-02: Certified weed-free materials (e.g., seed, forage, mulch, and fill) should be selected for all seeding and mulching projects to restore natural species composition and ecosystem function to the disturbed area, and to ensure that invasive weed species are not introduced during projects or emergency implementation.

New diseases, invasive species, and other novel pathogens are certain to be a persistent challenge under all alternatives; however, direction in the action alternatives specifically addresses activities and uses that might contribute to their associated negative impacts.

For a complete list of plan components that address ecological conditions associated with invasive species, disease, and other pathogens, and for a crosswalk showing how plan components address species-specific threats, see appendix G in volume 4.

Alternative B Effects

While alternative B does not contain any measures directly affecting the management of invasive species and other pathogens on the forest, some alternative plan components and management areas are likely to have indirect consequences.

In the proposed action (alternative B), opportunities for recreation are managed to balance public demand and natural resource desired conditions. Specifically, it includes objectives to develop or modify 2 to 8 systems of sustainably designated motorized and nonmotorized trails (e.g., bike trails, equestrian trails, dirt bike, jeep, and all-terrain vehicle trails) within 10 years of plan approval. It also includes an objective to maintain to standard, with participation from volunteer efforts and/or collaboratives, motorized and nonmotorized trails on at least 30 percent of the forest's designated routes annually. This focus on provided access while protecting natural resources assumes a potential for new roads and trails (both motorized and nonmotorized).

While both motorized and nonmotorized trails likely serve as vectors for invasive species and other pathogens, we consider motorized trails to have a somewhat greater impact overall due to heaver soil disturbance, potentially heavier traffic levels, and greater capacity of vehicles to transport seed and aquatic invasive species.

Although this alternative does not specify which types of trails will be developed or modified, we assume the potential that all systems could be developed as motorized trails, since this would have the greatest impact on at-risk species in this category. Additionally, the potential for new roads and trails, not included in the stated objective, is likely to lead to unintended introductions of nonnative species and pathogens.

Management Areas: Alternative B

Table 133. Effects of management areas in alternative B on invasive species and other pathogens

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	Restrictions on potential vectors of invasive species (i.e., motorized access, road construction, timber harvest, energy developments, and common variety mineral sales) is likely to help protect these areas from future invasions of nonnative species and the spread of other pathogens. Conversely, if infestations have already occurred or arise in the future, restrictions on mechanized use and motorized access may preclude the use of many integrated pest management techniques (e.g., chemical or mechanical treatments).
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Specific direction for management activities and permitted/allowed uses is likely to help reduce vectors of invasive species and other pathogens. Desired conditions for botanical areas are likely to lead to projects that decisions that work to protect these areas from invasive species and other pathogens.

Type of area	Name(s)	Effects
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Specific direction for management activities and permitted/allowed uses is likely to help reduce vectors of invasive species and other pathogens. Desired conditions for botanical areas are likely to lead to projects that decisions that work to protect these areas from invasive species and other pathogens.
Management Area	Lakes and Rivers Management Area	The emphasis on recreation opportunities in this management area is likely to lead to more invasions of nonnative species and spread of pathogens. Increased resources and work with partners may mitigate some of the effects of invasive species; however, eradication is often not feasible, and efforts are likely to focus on improving recreation opportunities.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, supplemental feeding of horses could result in the introduction of invasive species, as well as subsequent spread by horses. However, the lower Salt River area is already highly altered site with numerous nonnative species, and the past and future role of horses is unclear.

Alternative C Effects

In this alternative, opportunities are managed to favor nonmotorized and primitive recreation. It includes objectives to develop or modify 2 to 8 systems of nonmotorized trails and maintain to standard 30 percent of designated, nonmotorized routes annually. Objectives to decommission routes (10 miles of unneeded every 5 years) would focus solely on motorized routes. This focus on opportunities that favor nonmotorized and primitive recreation assumes a potential for fewer roads and trails (both motorized and nonmotorized). Since roads and trails are common vectors for invasive species and other pathogens, this alternative direction is the most beneficial in addressing the threat of invasive species.

Management Areas: Alternative C

Table 134. Effects of management areas in alternative C on invasive species and other pathogens

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	Restrictions on potential vectors of invasive species (i.e., motorized access, road construction, timber harvest, energy developments, and common variety mineral sales) is likely to help protect these areas from future invasions of nonnative species and the spread of other pathogens. Conversely, if infestations have already occurred or arise in the future, restrictions on mechanized use and motorized access may preclude the use of many integrated pest management techniques (e.g., chemical or mechanical treatments).

Type of area	Name(s)	Effects
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Specific direction for management activities and permitted/allowed uses is likely to help reduce vectors of invasive species and other pathogens. Desired conditions for botanical areas are likely to lead to projects that decisions that work to protect these areas from invasive species and other pathogens.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Specific direction for management activities and permitted/allowed uses is likely to help reduce vectors of invasive species and other pathogens. Desired conditions for botanical areas are likely to lead to projects that decisions that work to protect these areas from invasive species and other pathogens.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, supplemental feeding of horses could result in the introduction of invasive species, as well as subsequent spread by horses. However, the lower Salt River area is already highly altered site with numerous nonnative species, and the past and future role of horses is unclear.

Alternative D Effects

This alternative is more likely to contribute to the spread invasive species since it allows for additional roads to be built and provides no objectives for decommissioning routes. Greater access and increased disturbance is likely to exacerbate invasions of exotic species.

Management Areas: Alternative D

Table 135. Effects of management areas in alternative D on invasive species and other pathogens.

Type of area	Name(s)	Effects
Recommended Wilderness	None	No significant effects expected
Proposed Botanical Areas	None	No significant effects expected
Proposed Research Natural Areas	None	No significant effects expected
Management Area	Lakes and Rivers Management Area	The emphasis on recreation opportunities in this management area is likely to lead to more invasions of nonnative species and spread of pathogens. Increased resources and work with partners may mitigate some of the effects of invasive species; however, eradication is often not feasible, and efforts are likely to focus on improving recreation opportunities.

Type of area	Name(s)	Effects
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, supplemental feeding of horses could result in the introduction of invasive species, as well as subsequent spread by horses. However, the lower Salt River area is already highly altered site with numerous nonnative species, and the past and future role of horses is unclear.

Summary and Comparison of Effects

Alternative C is most likely to contribute the ecological conditions needed for species at-risk from invasive species, insects, disease, and other pathogens. This is due primarily to the increased emphasis on additional management areas that limit activities that serve as vectors for invasive species and other pathogens and limits on roads and motorized vehicle access forest wide. Alternative C also excludes the Lakes and Rivers Management Areas which increase the chances of further invasions and prioritizes recreation.

Alternative B differs from alternative C in that it proposes less recommended wilderness areas and allows for greater motorized access and trail construction, though other protective areas (proposed botanical and research natural areas and Proposed Research Natural Areas). Alternative D does not include any additional protected management areas and, similar to alternative B, allows for greater motorized access and trail construction, which then could result in additional invasions by nonnative species.

Alternative A is likely the least effective at addressing the risk of invasive species as it relies entirely on direction outside of the plan to provide the ecological conditions needed by species at risk of invasive species and other pathogens.

Plan Components that Provide Ecological Conditions for At-risk Species

The following table describe threats to persistence associated with invasive species, disease, and other pathogens for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 136. Plan components that address threats to at-risk species related to invasive species, disease, and other pathogens

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
Insects and other pathogens	Blumer's dock, Chiricahua leopard frog, Colorado pikeminnow, Fish Creek rock daisy, fringed myotis, lowland leopard frog, Mexican spotted owl, Tonto Basin agave	DWMA-DC-01; RWMA-DC-04; RERU-DC-17; ERU-DC-05; WAT-DC-04	CVK-G-02; INS-S-01; INS-G-06; INS-G-07; INS-G-09; REC-DIS-NMO-G-02; GRZ-G-06; ERU-G-10; ERU-G-11; REC-DIS-WB-G-01
Introgressive hybridization (nonnative species)	Gila trout	WFP-DC-06	WFP-G-03; WFP-G-04; WFP-G-08
Invasive, nonnative species	A mayfly, American dipper, broadleaf lupine, Chihuahuan sedge, Chiricahua leopard frog, Colorado pikeminnow, desert pupfish, Gila chub, Gila topminnow, Gila trout, loach minnow, lowland leopard frog, narrow-headed gartersnake, Northern Mexican gartersnake, razorback sucker, roundtail chub, southwestern willow flycatcher, spikedace, Verde Rim springsnail, yellow-billed cuckoo	DWMA-DC-06; INS-DC-01; RERU-DC-11; SL-DC-04; ERU-DC-10	INS-G-01; INS-S-01; INS-O-01; INS-S-02; INS-O-02; INS-G-02; INS-G-03; INS-G-04; INS-G-06; INS-G-08; INS-G-09; REC-DIS-NMO-G-02; RMZ-G-03; SU-S-03; ERU-O-04; ERU-G-07; ERU-G-08; REC-DIS-WB-G-01; WFP-G-08
Invasive, nonnative species (grasses)	Broadleaf lupine, Grand Canyon century plant, Hohokam agave, Tonto Basin agave	RERU-DC-11; SL-DC-04; ERU-DC-10	INS-S-01; INS-O-01; INS-G-01; INS-G-02; INS-O-02; INS-G-03; INS-G-08; SU-S-03; ERU-O-04; ERU-G-07; ERU-G-08

Recreation Impacts

Affected Environment

The Tonto National Forest has a very large and complex recreation program, and, with an estimated annual visitation of 4.8 million people, it is one of the most visited national forests in the country[11]. However, the current program is challenged by rising costs without available matching funds. Unmanaged recreation has been identified by the Forest Service as one of four key threats to the nation's forests and grasslands. On the Tonto National Forest, high levels of visitor use impact species and their habitats, especially in high-use areas. As the population in the Phoenix metropolitan area is projected to increase, it is likely that recreational visitor use of the forest will also continue to increase.

Table 137. At-risk species that may be negatively impacted by recreation activities

Common Name	Scientific name	Taxonomic group	At-risk species status
Allen's big-eared bat	*Idionycteris phyllotis*	mammal	species of conservation concern
A mayfly	*Fallceon eatoni*	invertebrate	species of conservation concern
Arizona bugbane	*Cimicifuga arizonica (syn. Actaea arizonica)*	plant	species of conservation concern
Arizona cliffrose	*Purshia subintegra*	plant	endangered
Blumer's dock	*Rumex orthoneurus*	plant	species of conservation concern

[11] A complete description of the existing condition of recreation on the Tonto National Forest, along with the analysis of the effects, by alternative, can be found in the Recreation section of this environmental impact statement. The following analysis takes those conclusions as part of the basis for this analysis.

Common Name	Scientific name	Taxonomic group	At-risk species status
Fish Creek fleabane	*Erigeron piscaticus*	plant	species of conservation concern
Fringed myotis	*Myotis thysanodes*	mammal	species of conservation concern
Grand Canyon century plant	*Agave phillipsiana*	plant	species of conservation concern
Mapleleaf false snapdragon	*Mabrya acerifolia*	plant	species of conservation concern
Mexican spotted owl	*Strix occidentalis lucida*	bird	threatened
Narrow-headed gartersnake	*Thamnophis rufipunctatus*	reptile	threatened
Northern Mexican gartersnake	*Thamnophis eques megalops*	reptile	threatened
Pale Townsend’s big-eared bat	*Corynorhinus townsendii pallescens*	mammal	species of conservation concern
Ripley wild buckwheat	*Eriogonum ripleyi*	plant	species of conservation concern
Sonoran desert tortoise	*Gopherus morafkai*	reptile	species of conservation concern
Southwestern willow flycatcher	*Empidonax traillii extimus*	bird	endangered
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	bird	threatened
Yuma Ridgeway’s rail	*Rallus obsoletus yumanensis*	bird	endangered

Effects Common to All Alternatives

The large number of recreationists on the Tonto National Forest comes with many potential effects to at-risk species and habitats. The proximity of the low deserts to the Phoenix metropolitan area results in concentrated use and heightens impacts that might otherwise be negligible. Riparian areas and lakes are disproportionately used by people and species on the forest. Heavy recreation in these areas can lower water quality, spread invasive species, erode or compact banks, trample vegetation, alter wildlife behavior, and more. Since desert species rely heavily on relatively rare water sources, effects may be fairly pronounced in these areas.

In more open areas, activities including off-road vehicle use, shooting, horseback riding, hiking, and camping can play roles in setting fires, disturbing wildlife, compacting soil, destroying biological crusts, increase erosion, harassment or direct mortality of wildlife and plants, etc. Such effects are not limited to deserts as recreation pressure increase in higher elevations during the summer. Here there is an added increase of unplanned ignitions in departed, forested systems.

The scale of recreational on the Tonto National Forest suggests that it is likely to pose a significant challenge to at-risk species and habitats in all alternatives. A set of alternatives was proposed for the recreation program and is analyzed in this report; however, because the alternatives for recreation focus primarily on motorized versus nonmotorized opportunities this analysis has been added to the Facilities, Roads, Construction, and Motorized Access sections due to similarities in effects and species affected. Generally, plan direction for the recreation program differs only between the non-action alternative (A) and the action alternatives (B, C, and D); however, we also address differences in the effects of recreation impacts on at-risk species for changes in special management areas by alternative.

Management Areas Common to All Alternatives

Table 138. Effects of management areas on recreation management

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	Because wilderness areas encourage primarily primitive, undeveloped, and nonmotorized recreation opportunities that emphasize a visitor experience of solitude, these areas are generally beneficial for species threatened by recreational activities.
Designated Wild and Scenic Rivers	Fossil Creek and Verde River	Effects for designated segments may have mixed effects. Management protection serves to protect and preserve the outstandingly remarkable values for which they were designated. Both Fossil Creek and the Verde River are designated wild and scenic, but have experienced high levels of recreation and associated impacts on plants and wildlife. While plan direction may include some additional protections for species (such as locating campgrounds, interpretive centers, or administrative headquarters outside of the river corridor), the recreation interest and management may lead to increased risks for sensitive species.
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	Plan direction for proposed research natural areas add additional protection and consideration for species sensitive to recreation. Examples include desired conditions for visitor access and use levels, as well as recreation uses that do not impair or degrade plant communities. Standards and guidelines prohibit camping, campfires, recreational shooting, and construction of new trails. These areas are likely to provide protection for species sensitive to recreational disturbance.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(No significant effects expected)
Significant Caves	17 significant caves (see forest plan for more info)	The locations of significant caves are safeguarded to prevent access from un-authorized users. Such direction provides protection for species associate with these caves that could be affected by unauthorized recreationalists.
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	These areas include plan direction to place public use areas outside of river corridors in classified “wild” segments. In “scenic” and “recreational” segments, such areas should still protect identified values. This would likely mitigate potential recreation impacts on eligible segments. Eligible segments have special guidance that recreation should be managed at appropriate locations and intensities to protect and enhance the free-flowing condition, and the outstandingly remarkable values, consistent with the classification.
Inventoried Roadless Areas	13 inventoried roadless areas	These areas provide added protection for species that may experience negative impacts from recreation since they favor dispersed recreation and are managed to be relatively undisturbed.

Type of area	Name(s)	Effects
Management Area	Saguaro Wild Burro Management Area	(No significant effects expected)
Management Area	Apache Leap Special Management Area	(No significant effects expected)

Alternative A Effects

Under alternative A, the challenges within the recreation program are likely to continue. The effects and impacts from many increasingly popular activities (e.g., rock climbing, water-based recreation, mountain biking) may not be addressed by current standards and guidelines. As demand continues to grow, especially in areas adjacent to the Phoenix metropolitan area, the 1985 plan will likely be inadequate to ensure that impacts to at-risk species are avoided or mitigated.

Management Areas: Alternative A

Table 139. Effects of management areas in alternative A on recreation management.

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	Plan direction for proposed research natural areas add additional protection and consideration for species sensitive to recreation. Examples include desired conditions for visitor access and use levels, as well as recreation uses that do not impair or degrade plant communities. Standards and guidelines prohibit camping, campfires, recreational shooting, and construction of new trails. These areas are likely to provide protection for species sensitive to recreational disturbance.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A – 6K	(No significant effects expected)

Effects Common to Alternatives B, C, D

Under all action alternatives, there is a wide array of plan direction that addressed potential impacts to at-risk species and sensitive habitats.

- REC-DC-01: Recreation contributes to enhanced quality of life for all of our visitors and the communities we serve. Recreation opportunities support healthy lifestyles and local businesses and jobs, contribute to vibrant local economies, and conserve water quality, at-risk species habitat, landscapes, and cultural resources.
- WFP-DC-07: Human-wildlife conflicts and human disturbances are minimal, as are impacts to vital life history functions (e.g., breeding, feeding, and rearing young) of wildlife, fish, and rare plants.
- FC-DC-06: Recreation and administrative sites complement the forests scenery desired conditions and do not cause damage to ecologically sensitive areas.

- REC-DIS-DC-01: Dispersed recreation provides visitors with diverse opportunities to recreate on land and water with minimal impacts to other natural resources (e.g., riparian areas, streams, lakes, and wetlands).
- REC-DIS-DC-06: Unauthorized user-created trails are not evident on the landscape.

Plan content directs projects, activities, and uses to be designed or located in areas that avoid sensitive habitats and mitigate/avoid impacts to at-risk species:

- REC-DIS-G-03: Newly constructed motorized and nonmotorized trails should not be located in or crossing the riparian management zone (which includes riparian areas, meadows, wetlands, seeps, springs, streams, and connected floodplains supporting riparian vegetation), meadows, sacred sites, or areas with high concentrations of significant archeological sites, unless the purpose is to provide for resource protection.
- CVK-G-02: Where necessary to protect human health and safety, gates should be installed to preserve habitats for and mitigate negative impacts to wildlife, including roosting bats. Proposed gates should be designed to allow future access for authorized personnel and include a lock and/or removable bar along with a design to open from the inside without a key.

Some plan components require consideration on habitat connectivity as part of potential impacts from recreation structures:

- WFP-G-08: New infrastructure or constructed features (e.g., fences, roads, recreation sites, facilities, drinkers, and culverts) should be designed and maintained to minimize negative impacts to the movement and dispersal of wildlife, fish, and rare plants. Infrastructure and constructed features already present that negatively impact movement and dispersal should be modified or removed when no longer in use in order to improve connectivity. Barriers may be used to protect native species or prevent movement of nonnative species.
- REC-G-04: Newly developed and dispersed recreation sites, facilities, and authorized activities should be designed and located in places so as not to degrade water quality, sensitive environments, or prevent wildlife access to water.

While recreation is likely to continue to have negative impacts on at-risk species and their habitats, all action alternatives contain plan content that seeks to mitigate or prevent impacts. Plan components also specify that conservation measures should be applied on at the project level for the protection of at-risk species (WFP-G-01 and WFP-G-04) while allowing for the flexibility to choose conservation measures that are most effective, specified by recovery plans, or agreed after consulting with related state or federal agencies. Additionally, plan content directing management of impacted ecosystems (riparian areas, watersheds and water resources, and ecological response units) calls for the restoration of sites disturbed by recreation activities.

For a complete list of plan components that address ecological conditions associated with mining impacts, and a crosswalk showing how plan components address species-specific threats related to recreation, see appendix G in volume 4.

Alternative B Effects

Impacts from plan components in alternative B are similar to alternatives C and D.

Management Areas: Alternative B

Table 140. Effects of management areas in alternative B on recreation management

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	As with designated wilderness, recommended wilderness areas encourage primarily primitive, undeveloped, and nonmotorized recreation opportunities that emphasize a visitor experience of solitude, these areas are generally beneficial for species threatened by recreational activities. Developed recreation sites and facilities that might concentrate use are not to be installed in recommended wilderness.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Plan direction for proposed botanical areas add additional protection and consideration for species sensitive to recreation. Examples include desired conditions for visitor access and use levels, as well as recreation uses that do not impair or degrade plant communities. Standards and guidelines prohibit camping, campfires, recreational shooting, and construction of new trails. These areas are likely to provide protection for species sensitive to recreational disturbance.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	As with botanical areas, plan direction for proposed research natural areas adds additional protection and consideration for species sensitive to recreation. Examples include desired conditions for visitor access and use levels, as well as recreation uses that do not impair or degrade plant communities. Standards and guidelines prohibit camping, campfires, recreational shooting, and construction of new trails. These areas are likely to provide protection for species sensitive to recreational disturbance.
Management Area	Lakes and Rivers Management Area	While much of the plan direction for this management area helps to mitigate potentially negative effects to habitat and species, the prioritization of recreation in this area is likely to result in long-term challenges for species sensitive to recreational impacts. Conversely, the emphasis on recreation in these areas may have the effect of concentrating recreational impacts, differing them from other, less impacted habitats. A good portion of the affected management area is already heavily impact by recreational use and the riparian and aquatic systems function artificially; thus, management activities for the expected growth in use is unlikely to increase impacts that already exist.

Type of area	Name(s)	Effects
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Horse viewing is a popular activity on the lower Salt River. This activity likely contributes to the many recreation impacts already present in the area (e.g., human presence, motor vehicle traffic, foot traffic, etc.). While trends in horse-viewing as activity are difficult to project, we do not anticipate that designation of the management area will directly result in any increases to recreation effects or alter the popularity of horse viewing.

Alternative C Effects

Management Areas: Alternative C

Impacts from plan components in alternative C are similar to alternatives B and D.

Table 141. Effects of management areas in alternative C on recreation management.

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	As with designated wilderness, recommended wilderness areas encourage primarily primitive, undeveloped, and nonmotorized recreation opportunities that emphasize a visitor experience of solitude, these areas are generally beneficial for species threatened by recreational activities. Developed recreation sites and facilities that might concentrate use are not to be installed in recommended wilderness.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Plan direction for proposed botanical areas add additional protection and consideration for species sensitive to recreation. Examples include desired conditions for visitor access and use levels, as well as recreation uses that do not impair or degrade plant communities. Standards and guidelines prohibit camping, campfires, recreational shooting, and construction of new trails. These areas are likely to provide protection for species sensitive to recreational disturbance.

Type of area	Name(s)	Effects
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	As with botanical areas, plan direction for proposed research natural areas adds additional protection and consideration for species sensitive to recreation. Examples include desired conditions for visitor access and use levels, as well as recreation uses that do not impair or degrade plant communities. Standards and guidelines prohibit camping, campfires, recreational shooting, and construction of new trails. These areas are likely to provide protection for species sensitive to recreational disturbance.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Horse viewing is a popular activity on the lower Salt River. This activity likely contributes to the many recreation impacts already present in the area (e.g., human presence, motor vehicle traffic, foot traffic, etc.). While trends in horse-viewing as activity are difficult to project, we do not anticipate that designation of the management area will directly result in any increases to recreation effects or alter the popularity of horse viewing.

Alternative D Effects

Impacts from plan components in alternative D are similar to alternatives B and C.

Management Areas: Alternative D

Table 142. Effects of management areas in alternative D on recreation management.

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	None	(No significant effects expected)

Type of area	Name(s)	Effects
Management Area	Lakes and Rivers Management Area	While much of the plan direction for this management area helps to mitigate potentially negative effects to habitat and species, the prioritization of recreation in this area is likely to result in long-term challenges for species sensitive to recreational impacts. Conversely, the emphasis on recreation in these areas may have the effect of concentrating recreational impacts, differing them from other, less impacted habitats. A good portion of the affected management area is already heavily impact by recreational use and the riparian and aquatic systems function artificially; thus, management activities for the expected growth in use is unlikely to increase impacts that already exist.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Horse viewing is a popular activity on the lower Salt River. This activity likely contributes to the many recreation impacts already present in the area (e.g., human presence, motor vehicle traffic, foot traffic, etc.). While trends in horse viewing as activity are difficult to project, we do not anticipate that designation of the management area will directly result in any increases to recreation effects or alter the popularity of horse viewing.

Summary and Comparison of Effects

Alternative C is the most likely alternative to provide the ecological conditions for species threatened by impacts from recreation. The emphasis on primitive recreation is likely to contribute to fewer impacts from motorized recreation. This alternative also contributes the largest amount of recommended wilderness, proposed botanical areas, proposed research natural areas, all of which have plan direction that add an additional layer of protection from potentially negative impacts. This alternative does not include the Lakes and Rivers Management Area prioritizing recreation along the large reservoirs and rivers on the forest, thus it is possible that without such a stated emphasis, future management may prioritize the otherwise standard plan direction for riparian and aquatic systems that focuses on the ecologic heath and function.

Alternative B is less specific on whether projects will focus on motorized versus nonmotorized recreation, thus it could result in more motorized recreation impacts to species. It also proposes substantially less recommended wilderness which is thought to provide some protection from heavy recreation impacts. Finally, the inclusion of the Lakes and Rivers Management Area seems unlike to reverse the substantial recreational impacts already present area.

In alternative D, the focus on motorized roads and trails is likely to increase the risk of negative impacts to species sensitive to this form of recreation. This alternative does not include additional, recommended wilderness, or proposed botanical areas, considered to have beneficial management for species negatively impacted by recreation. It does include the Lakes and Rivers Management Area, which may increase recreation related risks to species.

Alternative A is largely silent on many of the impacts recreation can pose to at-risk species and relies primarily on direction for other law, regulation, and policy to address recreational impacts to species.

Plan Components that Provide Ecological Conditions for At-risk Species

The following table describe threats to persistence associated with recreation impacts for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 143. Plan components that address threats to at-risk species related to recreation impacts

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
impacts from recreation activities	A mayfly, Arizona bugbane, Arizona cliffrose, Blumer's dock, Fish Creek fleabane, Grand Canyon century plant, mapleleaf false snapdragon, Mexican spotted owl, narrow-headed gartersnake, Northern Mexican gartersnake, Sonoran desert tortoise, southwestern willow flycatcher, yellow-billed cuckoo, Yuma Ridgeway's rail	REC-DIS-DC-01; REC-DIS-DC-03; REC-DIS-DC-05; REC-DIS-MO-DC-03; REC-DC-01; REC-DC-08; REC-DIS-RS-DC-01; REC-DIS-RS-DC-04; REC-DIS-WB-DC-04	REC-DEV-O-01; REC-DEV-S-01; REC-DIS-G-02; REC-DIS-S-02; REC-DIS-G-03; REC-DIS-S-03; REC-DIS-MO-G-01; REC-DIS-MO-S-02; REC-DIS-NMO-G-02; REC-DIS-NMO-G-03; REC-DIS-NMO-G-04; REC-O-03; REC-G-03; REC-O-04; REC-G-04; REC-G-07; REC-G-09; REC-DIS-WB-G-01
off-road vehicle use	Arizona cliffrose, Ripley wild buckwheat, Sonoran desert tortoise	DWMA-DC-08; REC-DIS-MO-DC-03	RNBAMA-G-02; RNBAMA-G-06; DWSRMA-G-01; REC-DIS-G-03; REC-DIS-G-04; EWSRMA-G-02; REC-DIS-MO-G-01; REC-DIS-MO-S-02; REC-DIS-MO-G-02; REC-DIS-MO-G-03; RWMA-G-01; RWMA-S-01; RD-G-01; RD-S-01; RD-G-02; WAT-G-08; REC-WR-G-01

Mining and Energy Impacts

Affected Environment

Mining and energy development is a prominent resource on the Tonto National Forest.[12] Over 20 mining districts recognized within the planning area are past or current producers of nonrenewable mineral commodities. The largest of these districts, the Globe-Miami mining district is well known for its large, disseminated copper deposits and has been identified as one of America's premier copper mining districts. The Pioneer mining district, located just west of the Globe-Miami district, continues to attract interest with the discovery and development of the Resolution Copper project, considered to be one of the world's top ten undeveloped copper resources (USDA Forest Service 2021).

The forest has a legacy of un-reclaimed mine and prospecting sites from the early prospectors. The remediation of abandoned mine land features is publicly funded, with the purpose of reducing hazards and

[12] A complete description of the existing condition of mining and energy on the Tonto National Forest, along with the analysis of the effects, by alternative, can be found in the Mining, Minerals, and Abandoned Mines; and Energy Production and Delivery sections of this environmental impact statement. The following analysis takes those conclusions as part of the basis for this analysis.

health risks associated with these legacy sites. The abandoned mine lands remediation program identifies abandoned mine land features within a defined project boundary on an annual basis.

This section focuses on the effects of mining and energy development on plant and animal populations and habitats. Many aspects of the mine and energy operations have the potential to affect individuals, populations, and habitat for plants and animals, including at-risk species.

Table 144. At-risk species for which mining and energy development may impact persistence

Common Name	Scientific name	Taxonomic group	At-risk species status
Arizona cliffrose	*Purshia subintegra*	plant	endangered
Arizona hedgehog cactus	*Echnocereus triglochidiatus* var. *arizonicus*	plant	endangered
Chiricahua leopard frog	*Lithobates chiricahuensis*	amphibian	threatened
Gila rock daisy	*Perityle gilensis* var. *gilensis*	plant	species of conservation concern
Mapleleaf false snapdragon	*Mabrya acerifolia*	plant	species of conservation concern
Milk Ranch Talussnail	*Sonorella micromphala*	invertebrate	species of conservation concern
Richinbar talussnail	*Sonorella ashmuni*	invertebrate	species of conservation concern

Effects Common to All Alternatives

All plan alternatives provide for the occurrence of current and future mineral and energy development. Such projects may have numerous impacts where they occur. While mining and energy development may impact many species and habitats, it is a particular concern for some at-risk species.

Mining pits, plants, tailings, waste rock facilities, roads, utility corridors, and other facilities have the potential to permanently change vegetation, and reclamation efforts may not restore vegetation to pre-project conditions. Both mining and energy developments have the potential to create conditions conducive to the introduction, establishment, and/or spread of nonnative species, which may displace native plants and animals. Landscape alterations (e.g., roads, tailings, pits, etc.) can lead to habitat fragmentation, preventing natural movements of affected species. Some projects have can negatively impact important riparian and aquatic habitats and corridors, through water withdrawals, pollutants, or other impacts. Mines and energy development can result in a loss or alteration of habitat for numerous plant and animal species.

In addition to impacts on species habitats, mining and energy projects (e.g., construction, drilling and blasting), may result in noise and vibrations, which could impact animal behavior and result in negative impacts on wildlife. Similarly, nocturnal and other animals may be adversely affected by the light glow in night skies.

Management Areas Common to All Alternatives

Table 145. Effects of management areas on mining and energy management

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	(No significant effects expected)
Designated Wild and Scenic Rivers	Fossil Creek and Verde River	Management for locatable and leasable minerals includes additional considerations to either minimize ecological impacts or protect the values in the river corridor. Disposal of saleable mineral materials is generally not permitted. For those species at risk of effects from mining activities, management direction may help prevent and/or mitigate some impacts.
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	Sales or extraction of common variety minerals is not permitted in these areas, preventing impacts to species from this particular mining activity.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(No significant effects expected)
Significant Caves	17 significant caves (see forest plan for more info)	(No significant effects expected)
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	Management for locatable and leasable minerals includes additional considerations to either minimize ecological impacts or protect the values in the river corridor. Disposal of saleable mineral materials is generally not permitted. For those species at risk of effects from mining activities, management direction may help prevent and/or mitigate some impacts.
Inventoried Roadless Areas	13 inventoried roadless areas	(No significant effects expected)
Management Area	Saguaro Wild Burro Management Area	(No significant effects expected)
Management Area	Apache Leap Special Management Area	(No significant effects expected)

Effects Common to Alternatives B, C, D

While both short-term and long-term impacts to species and habitats are expected from ongoing and future mineral and energy projects, the action alternatives contain numerous measures to prevent or mitigate negative impacts during project implementation.

Some plan direction focuses on protecting sensitive habitat types or locations associated with at-risk species:

- MMAM-G-03: Placer mining should avoid damaging riparian vegetation, degrading water quality, and negatively impacting channel stability.
- RNBAMA-S-01: Sales or extraction of mineral materials shall not be authorized in designated or recommended research natural areas and botanical areas.

Plan content also directs reclamation and mitigation efforts:

- MMAM-S-02: Required reclamation activities shall be designed to establish resilient post-mining ecosystems consistent with the pre-disturbance ecological response unit if possible, or to an ecological response unit identified as achievable to the post-mining landscape condition.
- MMAM-G-04: Surface reclamation and revegetation plans for smaller scale mineral activities (e.g., drilling programs or smaller scale open pits), should plan for a natural species succession appropriate to the reclaimed landform and vegetative community for the identified Ecological Response Unit, to include identifying appropriate species to use in revegetation of disturbed areas.

In some cases, abandoned mine features may serve as important habitat; thus, plan components are also used to preserve the habitat function of these alterations:

- MMAM-G-06: Abandoned mine features (e.g., adits, shafts, and stopes) should be closed when a feature poses a danger to the public. If the feature is determined to contain wildlife habitat (e.g., maternity roosts or hibernacula for bats) or contain cultural resources, gating should be considered. Installed gates should conform to bat-friendly standards and be designed in such a way to allow for the safe passage of wildlife.

While plan direction is not expected to prevent all negative impacts, it does lay a foundation for how to address these impacts. In addition, plan content guiding the overall management of important habitat (e.g., riparian management areas, watersheds and water resources, and ecological response units) provides direction to improve habitats that may have been or may be degrades as a result of mining and energy products, helping to address specific impacts cause by mining and energy development projects.

For a complete list of plan components that address ecological conditions associated with mining and energy development, and a crosswalk showing how plan components address species-specific threats, see appendix G in volume 4.

Alternative A Effects

Management Areas: Alternative A

Table 146. Effects of management areas in alternative A on mining and energy management

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	Sales or extraction of common variety minerals is not permitted in these areas, preventing impacts to species from this particular mining activity.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A – 6K	(No significant effects expected)

Alternative B Effects

The proposed action (alternative B) includes a guideline specifying that mineral materials (e.g., sand and gravel) should not be removed from the riparian management zone without adequate engineering controls to protect surface waters (plan component MMAM-G-01). While this direction is likely to have some benefits for species at the project level, it would only serve species found within the riparian management zone. Of the species considered at risk to mining activities, only a few depend on riparian areas regularly.

Ultimately, this guideline does allow extracting of mineral materials in riparian areas and only specifies that mitigations should be provided. This type of guidance is not substantially different from other types of plan direction provided for projects in riparian areas. Thus, the overall effect is likely of small consequence.

Management Areas: Alternative B

Table 147. Effects of management areas in alternative B on mining and energy management.

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	Sales or extraction of common variety minerals shall not be permitted in a recommended wilderness area.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas.
Management Area	Lakes and Rivers Management Area	(No significant effects expected)
Management Area	Salt River Horse Management Area	(No significant effects expected)

Alternative C Effects

This alternative proposes a standard that mineral materials (e.g., sand and gravel) shall not be removed from the riparian management zone. This prohibition is likely to protect very important riparian areas from potentially disruptive impacts; however, it may only benefit a relatively few species identified as being at risk of future persistence on the forest due to mining activities. Notwithstanding, aquatic and riparian areas in the southwest are extremely important habitat for many species, and this alternative is likely to increase the integrity and function of these systems.

Management Areas: Alternative C

Table 148. Effects of management areas in alternative C on mining and energy management.

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	Sales or extraction of common variety minerals shall not be permitted in a recommended wilderness area, preventing impacts to species from this particular mining activity.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Sales or extraction of common variety minerals is not permitted in these areas, preventing impacts to species from this particular mining activity.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Sales or extraction of common variety minerals is not permitted in these areas, preventing impacts to species from this particular mining activity.
Management Area	Salt River Horse Management Area	(No significant effects expected)

Alternative D Effects

This alternative provides no specific direction (as is also the case in alternative A). We expect that ultimately this alternative would function similarly to the proposed action (alternative B) due to the expanded direction for riparian ecological response units and riparian management zones. As projects for mineral materials are proposed in the future, the desired conditions, standards, and guidelines for these areas would be considered and mitigation measures would be implemented. As such, the benefits to species is likely to be similar to those described in the proposed action.

Management Areas: Alternative D

Table 149. Effects of management areas in alternative D on mining and energy management.

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	None	(No significant effects expected)
Management Area	Lakes and Rivers Management Area	(No significant effects expected)
Management Area	Salt River Horse Management Area	(No significant effects expected)

Summary and Comparison of Effects

While proposed guidance on mineral material (sand and gravel) withdrawal in riparian management zones does vary by alternative, we predict that these plan components would only provide a minimal benefit to at-risk species threatened by mineral development. Alternative C is the most effect at mitigating this particular risk as it prohibits these types of projects. In the case of other alternatives, the additional direction regarding riparian areas throughout the plan that requires careful consideration on activities affecting these areas. Thus, we expect that similar types of mitigations and permitting procedures are likely to similar in alternatives A, B, and D.

Overall, the largest impacts to species and their habitats come from other types of mining and energy related activities. These threats to species and their habitats are addressed by a range of plan components in the action alternatives that ultimately provide the ecological conditions necessary for persistence of species at risk due to mining and energy development.

Plan Components that Provide Ecological Conditions for At-risk Species

Table 150 lists the at-risk species potentially threatened by mining and energy impacts and identifies plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 150. Plan components that address threats to at-risk species related to mining and energy impacts

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
mining activity and development	Arizona cliffrose, Arizona hedgehog cactus, Chiricahua leopard frog, Fringed myotis, Gila rock daisy, Mapleleaf false snapdragon, Milk Ranch Talussnail, Pale Townsend's big-eared bat, Richinbar talussnail	MMAM-DC-01; MMAM-DC-02	MMAM-G-01; MMAM-G-03; MMAM-S-02; MMAM-G-04; MMAM-G-06

Grazing Impacts

Affected Environment

Rangelands are shrublands, woodlands, wetlands, and deserts that are grazed by domestic livestock or wild animals. Livestock grazing began on the area now known as the Tonto National Forest in the late 1800s[13]. The forest is unique in that it is one of the few national forests that permits year-long grazing.

Currently, the forest is divided into 106 cattle and horse allotments and one sheep driveway. These allotments are held by 85 term grazing permit holders. Several of the permittees hold more than one grazing permit and run multiple herds or use one allotment for part of the year and move to another allotment later. Most permittees are dependent entirely on federal grazing permits due to the scarcity of private lands in Arizona.

A collaborative rangeland monitoring program called Reading the Range, led by the University of Arizona, was initiated on the forest in 2001. The monitoring program now includes 57 allotments encompassing 1.48 million acres on the forest. In a coarse review of approximately 265 Reading the Range monitoring sites, most monitoring sites are stable or upward in trend for the time monitored. Some rangelands are continuing to heal after large wildfires. Other areas are recovering from drought. Invasive and exotic grasses on the forest continue to increase, and other invasive species remain a threat to rangelands.

Table 151. At-risk species that may experience negative impacts in response to grazing

Common Name	Scientific name	Taxonomic group	At-risk species status
Ancha mountainsnail	*Oreohelix anchana*	invertebrate	species of conservation concern
Arizona cliffrose	*Purshia subintegra*	plant	endangered

[13] A complete description of the existing condition of grazing on the Tonto National Forest, along with the analysis of the effects, by alternative, can be found in the Rangelands, Forage, and Grazing section of this environmental impact statement. The following analysis takes those conclusions as part of the basis for this analysis.

Common Name	Scientific name	Taxonomic group	At-risk species status
Arizona hedgehog cactus	*Echnocereus triglochidiatus var. arizonicus*	plant	endangered
Blumer's dock	*Rumex orthoneurus*	plant	species of conservation concern
Chihuahuan sedge	*Carex chihuahuensis*	plant	species of conservation concern
Chiricahua leopard frog	*Lithobates chiricahuensis*	amphibian	threatened
Colorado pikeminnow	*Ptychocheilus lucius*	fish	endangered, experimental population, non-essential
Fossil springsnail	*Pyrgulopsis simplex*	invertebrate	species of conservation concern
Loach minnow	*Tiaroga cobitis*	fish	endangered
Mexican spotted owl	*Strix occidentalis lucida*	bird	threatened
Mexican wolf	*Canus lupus baileyi*	mammal	endangered, experimental population, non-essential
Northern Mexican gartersnake	*Thamnophis eques megalops*	reptile	threatened
Razorback sucker	*Xyrauuchen texanus*	fish	endangered
Ripley wild buckwheat	*Eriogonum ripleyi*	plant	species of conservation concern
Roundtail chub	*Gila robusta*	fish	species of conservation concern
Sonoran maiden fern	*Thelypteris puberula* var. *sonorensis*	plant	species of conservation concern
Sonoran desert tortoise	*Gopherus morafkai*	reptile	species of conservation concern
Southwestern willow flycatcher	*Empidonax traillii extimus*	bird	endangered
Spikedace	*Meda fulgida*	fish	endangered
Verde Rim springsnail	*Pyrgulopsis glandulosa*	invertebrate	species of conservation concern
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	bird	threatened
Yuma Ridgeway's rail	*Rallus obsoletus yumanensis*	bird	endangered

Effects Common to All Alternatives

Effects to species may be beneficial, neutral, or negative. In some areas, grazing may alter vegetation structure and composition, increase competition for forage or water, or change behavior of wildlife. Some species may be impacted when burrows or nests are trampled. In contrast, other species benefit directly from livestock grazing. For example, the federally listed Chiricahua leopard frog relies heavily on stock tanks in parts of its range.

Management Areas Common to All Alternatives

Table 152. Effects of management areas on grazing management.

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	(No significant effects expected)
Designated Wild and	Fossil Creek and Verde River	Domestic livestock grazing and constructed range improvements within the river corridor do not impact the river

Type of area	Name(s)	Effects
Scenic Rivers		segment's outstandingly remarkable values and are consistent with the river segment's classification.
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	In these areas, allotment management plans should have provisions to protect the uniqueness, ecological condition, and biological diversity of designated or proposed research natural areas and botanical areas that occur within an active grazing allotment. Livestock grazing should not be authorized in designated or proposed research natural areas where it interferes with current and/or ongoing research. This plan direction is likely to benefit species sensitive to grazing in research natural areas.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(No significant effects expected)
Significant Caves	17 significant caves (see forest plan for more info)	(No significant effects expected)
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	Desired conditions for these segments may increase considerations and constrain management activities for grazing and water developments.
Inventoried Roadless Areas	13 inventoried roadless areas	(No significant effects expected)
Management Area	Saguaro Wild Burro Management Area	(No significant effects expected)
Management Area	Apache Leap Special Management Area	Apache Leap Special Management Area is closed to grazing in the current plan and would continue to be closed to grazing.

Alternative A Effects

Alternative A continues current management to balance livestock numbers with forage capacity. Existing grazing permits would continue to be reissued. Grazing levels would remain similar to today's levels. Overall rangeland health should remain static.

Under the current management, species at risk of grazing impacts would continue to be exposed on most of the forest, except for the few locations withdrawn from grazing. While most conflicts between at-risk species could be addressed at the allotment level, there is relatively little plan direction in the existing plan to dictate how concerns should be address.

Most conservation actions and mitigation measures related to range management would result from policies contained outside of the forest plan. Federally threatened and endangered species would still be considered as part the grazing program. However, the current plan does contain guidance specific to species of conservation concern in regard to grazing. As a result, it is unlikely that allotment management plans would address concerns for many of the new species identified as species of conservation concern.

Management Areas: Alternative A

Table 153. Effects of management areas in alternative A on grazing management

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	In these areas, allotment management plans should have provisions to protect the uniqueness, ecological condition, and biological diversity of designated or proposed research natural areas and botanical areas that occur within an active grazing allotment. Livestock grazing should not be authorized in designated or proposed research natural areas where it interferes with current and/or ongoing research. This plan direction is likely to benefit species sensitive to grazing in research natural areas.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A – 6K	(No significant effects expected)

Effects Common to Alternatives B, C, D

Desired conditions in all action alternatives strive to achieve healthy rangelands and consider impacts to species and their habitats.

- GRZ-DC-02: Rangelands are resilient to disturbances, fluctuations, and extremes in the natural environment (e.g., fire, flooding, drought, climate variability).
- GRZ-DC-03: Livestock grazing allows for healthy, diverse plant communities, satisfactory soil and water conditions, and sustains the quality and quantity of fish and wildlife habitat.

Plan components in these alternatives focus on adaptive management in order to minimize negative impacts to at-risk species and sensitive habitats. Plan content directs actions to be taken but allows for site-specific considerations and monitoring.

- WFP-DC-07: Human-wildlife conflicts and human disturbances are minimal, as are impacts to vital life history functions (e.g., breeding, feeding, and rearing young) of wildlife, fish, and rare plants.
- WFP-G-04: Projects and activities that may negatively impact at-risk species should consider protections and mitigation measures, especially considering the timing and location of vulnerable life history processes (e.g., reproduction, molting, migration, and hibernation). Examples of mitigations and protections could include but are not limited to: Timing restrictions, adaptive percent utilization levels, distance buffers.
- GRZ-S-01: Livestock use in and around riparian areas will be evaluated on an allotment specific basis. Design elements (e.g., deferment, herding, and fencing) will be implemented where needed.

Plan components in the action alternatives provide direction that specifically protects riparian areas and other sensitive habitats.

- RERU-G-02: Livestock and wildlife management practices should allow riparian vegetation to recover. Plant development or recovery sufficient to sustain healthy riparian areas should occur following each livestock use period.
- RMZ-DC-05: Forest activities (e.g., vehicle use, recreation, ungulate and livestock grazing) do not negatively impact and move riparian areas away from desired conditions for vegetation, soils, and water (e.g., increase sedimentation and erosion, alter plant communities, or impair streambanks).
- GRZ-G-02: Salt or mineral supplements should not be placed near riparian, wetland, or other areas where livestock concentrations are undesired.

Prevent overgrazing.

- GRZ-G-04: Livestock rotations should avoid grazing the same areas during the growing season at the same time, year after year.
- GRZ-G-08: When unauthorized livestock are found occupying National Forest lands, the owner should be promptly notified to remove them and prevent them from re-entering National Forest lands. If the owner is unknown or uncooperative, impoundment procedures should be initiated.
- GRZ-G-09: A stock and monitor approach incorporating best available science should be used when evaluating stocking rates in grazing decisions.

Consider species-specific impacts.

- GRZ-G-05: Wildlife escape ramps should be installed in all livestock water troughs and open storage tanks.
- GRZ-G-06: Efforts (e.g., coordination with permittees, temporary fencing, increased herding, and herding dogs) should be made to prevent transfer of disease from domestic sheep and goats to bighorn sheep wherever bighorn sheep occur. Allotment conversions from cattle to domestic sheep or goats should not be allowed in areas adjacent to or inhabited by bighorn sheep.

For a complete list of plan components that address ecological conditions associated with grazing impacts, and a crosswalk showing how plan components address grazing threats, see appendix G in volume 4.

Alternative B Effects

Direction for grazing in this alternative specifies that vacant allotments should be evaluated for one of the following options every two years, until there are no vacant allotments: a) conversion to forage reserves to improve resource management flexibility, b) grant to current or new permittees, or c) closure to permitted grazing, in whole or in part.

While such direction could potentially result in plan direction that benefits, is neutral, or negatively impacts species at risk from grazing impacts, we will address the most impactful scenario in which all allotments remain open.

Should all allotments remain open, they may also be grazed in the future. As mentioned above, proper grazing practices may mitigate effects for many species; however, some species are likely to experience direct and/or indirect impacts in or near actively grazed areas. Under alternative B, this potential would exist in any area on the forest that is not withdrawn from grazing.

While the forest plan may allow for grazing on all allotments, each allotment would be managed under a specific allotment management plan that should consider mitigations for at-risk species where there is a potential for negative impacts. For federally listed species, many grazing activities would require consultation with US Fish and Wildlife to ensure proper measures to protect threatened and endangered species as well as designated critical habitat.

Management Areas: Alternative B

Table 154. Effects of management areas in alternative B on grazing management.

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	(No significant effects expected)
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Livestock grazing will not be authorized in proposed or designated botanical areas.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	In these areas, allotment management plans should have provisions to protect the uniqueness, ecological condition, and biological diversity of designated or proposed research natural areas and botanical areas that occur within an active grazing allotment. Livestock grazing should not be authorized in designated or proposed research natural areas where it interferes with current and/or ongoing research. This plan direction is likely to benefit species sensitive to grazing in research natural areas.
Management Area	Lakes and Rivers Management Area	Permitted livestock are only authorized where existing infrastructure or natural boundaries prevent livestock from accessing the rivers and lakes (LRMA-G-05). As such, at-risk species sensitive to grazing impacts may benefit in some portions of this area (e.g., the Verde River and some portions of the reservoirs). An exception would be where the Salt River Horse Management Area overlaps with this area.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, ongoing presence of horses is likely to degrade habitat by damaging vegetative ground cover, soils, stream banks, and riparian vegetation. Some wildlife may have to compete for forage and other resources. In the past, the horse population has been sustained beyond carrying capacity via supplemental feeding. High numbers of large ungulates in a concentrated desert system are very likely to result in adverse impacts to species that are sensitive to grazing impacts.

Alternative C Effects

Closing vacant allotments would also likely have neutral to positive effects for species sensitive to grazing pressures. Vacant allotments are not currently being grazed, so any positive impact apply only to future grazing, not the current condition. Reduction in fences and infrastructure as well as disturbance associated with grazing in closed allotments may be beneficial to at-risk species. For some however, closing allotments could result in fewer stalk ponds and drinkers, which are important to some species (e.g., Chiricahua leopard frog, bats, and large mammals). In general, the preclusion of livestock via the closure of vacant allotments is likely benefit at-risk species and habitats that are sensitive to such use.

Management Areas: Alternative C

Table 155. Effects of management areas in alternative C on grazing management

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	(No significant effects expected)
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Livestock grazing will not be authorized in proposed or designated botanical areas.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	In these areas, allotment management plans should have provisions to protect the uniqueness, ecological condition, and biological diversity of designated or proposed research natural areas and botanical areas that occur within an active grazing allotment. Livestock grazing should not be authorized in designated or proposed research natural areas where it interferes with current and/or ongoing research. This plan direction is likely to benefit species sensitive to grazing in research natural areas.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, ongoing presence of horses is likely to degrade habitat by damaging vegetative ground cover, soils, stream banks, and riparian vegetation. Some wildlife may have to compete for forage and other resources. In the past, the horse population has been sustained beyond carrying capacity via supplemental feeding. High numbers of large ungulates in a concentrated desert system are very likely to result in adverse impacts to species that are sensitive to grazing impacts.

Alternative D Effects

In alternative D, at least one vacant allotment is to be evaluated and granted to a current or new permittee every two years, until there are no vacant allotments. If additional allotments are waived without preference, they will be evaluated and granted to a current or new permittee as part of the above two year timeframe.

Granting vacant allotments to other permittees is likely to result in additional grazing in areas of the forest that have not been grazed in recent years. Allotment management plans should take into account the needs of at-risk species (including federally listed species), but direct and/or indirect impacts are still likely to occur and affects some species. Effectively, this alternative could have impacts very similar to the proposed action (alternative B).

Management Areas: Alternative D

Table 156. Effects of management areas in alternative D on grazing management

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	None	(No significant effects expected)
Management Area	Lakes and Rivers Management Area	Permitted livestock are not authorized in this management area. As such, at-risk species sensitive to grazing impacts may benefit in some portions of this area (e.g., the Verde River and some portions of the reservoirs). An exception would be where the Salt River Horse Management Area overlaps with this area.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Within the management area, ongoing presence of horses is likely to degrade habitat by damaging vegetative ground cover, soils, stream banks, and riparian vegetation. Some wildlife may have to compete for forage and other resources. In the past, the horse population has been sustained beyond carrying capacity via supplemental feeding. High numbers of large ungulates in a concentrated desert system are very likely to result in adverse impacts to species that are sensitive to grazing impacts.

Summary and Comparison of Effects

All action alternatives are likely to decrease the effects on species sensitive to grazing due to the addition of more explicit plan direction for rangelands, vegetative communities (ecological response units), and riparian areas. Generally, alternative C is considered most effective at reducing grazing effects to species because it is likely to result in fewer allotments grazed. Alternatives B and C both propose new research natural and botanical areas which have additional guidance for grazing that is likely beneficial for species in these areas. While the areas are typically quite small, they are likely disproportionately important to at-risk species (especially plants) since their designation corresponds to important or rare plant and animal communities. Alternative A has fewer specific standards and guidelines that help to address impacts to at-risk species.

In general, most effects to federally listed species will continue to be addressed at the project level, ensuring that grazing impacts are mitigated or avoided and do not jeopardize species. Plan components in all action alternatives directs future projects and activities that may negatively impact at-risk species to consider protections and mitigation measures, especially considering the timing and location of vulnerable life history processes. Such considerations should use the best available science and/or conservation measures should be used to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, maintain viable populations of species of conservation concern.

Plan Components that Provide Ecological Conditions for At-risk Species

Table 157 describes threats to persistence associated with grazing impacts for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 157. Plan components that address threats to at-risk species related to grazing impacts

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
Impacts from livestock grazing	Ancha mountainsnail, Arizona cliffrose, Arizona hedgehog cactus, Blumer's dock, Chihuahuan sedge, Chiricahua leopard frog, Colorado pikeminnow, fossil springsnail, loach minnow, Mexican spotted owl, Mexican wolf, Northern Mexican gartersnake, razorback sucker, Ripley wild buckwheat, roundtail chub, Sonoran maiden fern, southwestern willow flycatcher, spikedace, Verde Rim springsnail, yellow-billed cuckoo, Yuma Ridgeway's rail	GRZ-DC-02; GRZ-DC-03	GRZ-O-01; GRZ-G-02; GRZ-G-04; GRZ-G-05; GRZ-G-06; GRZ-G-07; GRZ-G-08

Facilities, Roads, Construction, and Motorized Access

Affected Environment

There are roughly 4,295 miles of National Forest System roads across the Forest. Road systems provide access to public lands and private in-holdings, The Tonto road system provides access to the following resource areas; administration, recreation, vegetative management, wildland fire management, livestock grazing, habitat restoration, natural resource development, electronic utility corridor development and maintenance, minerals, as well has monitoring activities.[14] The roads system also includes related features such as culverts, grade dips, cattle guards, signage, etc.

Table 158. At-risk species associated disturbance from facilities, roads, construction, and motorized access

Common Name	Scientific name	Taxonomic group	At-risk species status
Blumer's dock	*Rumex orthoneurus*	plant	species of conservation concern
Colorado pikeminnow	*Ptychocheilus lucius*	fish	endangered, experimental population, nonessential
Fossil springsnail	*Pyrgulopsis simplex*	invertebrate	species of conservation concern
Loach minnow	*Tiaroga cobitis*	fish	endangered
Milk Ranch Talussnail	*Sonorella micromphala*	invertebrate	species of conservation concern

[14] A complete description of the existing condition of facilities, roads, construction, and motorized access on the Tonto National Forest, along with the analysis of the effects, by alternative, can be found in the Facilities, Roads, and Recreation sections of this environmental impact statement. The following analysis takes those conclusions as part of the basis for this analysis.

Common Name	Scientific name	Taxonomic group	At-risk species status
Ocelot	*Leopardus pardalis*	mammal	endangered
Roundtail chub	*Gila robusta*	fish	species of conservation concern
Sierra Ancha talussnail	*Sonorella anchana*	invertebrate	species of conservation concern
Sonoran desert tortoise	*Gopherus morafkai*	reptile	species of conservation concern
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	bird	threatened

Effects Common to All Alternatives

Roads and trails can directly affect terrestrial species by increasing mortality for species crossing, basking, or foraging on or adjacent to roads. Overtime, this can reduce recruitment, particularly with species that have long maturation times (Bury et al. 1977).

Roads and trails indirectly affect terrestrial species through 1) loss of habitat due to conversion of native vegetation to a particular road/trail surface (paved, gravel, dirt); 2) fragmentation of habitats due to a road and trail system development; 3) interruption in migratory patterns of wildlife to reach breeding habitat or winter range habitat; and 4) lack of habitat use by wildlife due to disturbance caused by use of the road or trail system. Conversely, roads and trails can also provide a means of dispersal for some species and can increase edge effects in more contiguous habitats. In a similar way, roads and trials are often vectors for invasive plant species.

While the totals of direct habitat loss are relatively low, there is an indirect habitat loss that includes the area around roads where wildlife will avoid using habitat. Species may occasionally use areas near roads and trails; however, most wildlife species tend to avoid these areas, and increasingly so where there are high levels of traffic. Wisdom et al. (2004) found that recreational activities had a substantial effect on movement rates and flight responses for elk, with ATV use and mountain biking having greater effects on movement rates and flight responses than horseback riding and hiking. Noise from developing, using, and maintaining roads affect wildlife within hearing distance. Noise from off-road vehicles can be at volumes and levels that harass desert animals (Bury 1980), even in underground retreats and burrows (Bondello 1976).

Facilities and construction activities are likely to result in similar effects as described for roads and trails; however, their overall footprint on the forest is generally smaller. Recreation facilities and construction related to utilities also have the potential to impact wildlife behavior, alter local habitats, and cause direct mortality to at-risk species (especially rare plants if not detected).

While the proposed alternatives do vary in the degree to which facilities, roads, construction, and motorized access are administered, all alternatives are likely to face similar challenges to at-risk species and habitats as these uses are an important part of the recreation and economic contributions to forest users.

Management Areas Common to All Alternatives

Table 159. Effects of management areas on facilities, roads, construction, and motorized access

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	Direction that prohibits motorized/mechanized uses and building of roads is likely to reduce the potential for negative impacts on species sensitive to construction activities and motorized access.

Type of area	Name(s)	Effects
Designated Wild and Scenic Rivers	Fossil Creek and Verde River	Designated river segments have specific standards for construction of facilities and roads that may be beneficial for species sensitive to these activities. Principally, new roads or motorized trails are not to be built in designated "wild" segments.
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	Designated areas include direction that prefers foot traffic over other forms of transportation and specifies that new trails (motorized and nonmotorized) should not be constructed. Logging and fuelwood gathering is not permitted in these areas, decreasing construction and road risks associated with vegetation and timber management.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(No significant effects expected)
Significant Caves	17 significant caves (see forest plan for more info)	(No significant effects expected)
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	Similar to designated wild and scenic river segments, eligible segments have direction that specifies that new roads or motorized trails should not be built in the river corridor. They also specify that constructed range improvements should not impact the outstandingly remarkable values associated with the segment. While the elevated considerations may result in decreased risks related to construction and motorized roads/trails, such direction is likely be most beneficial for eligible "wild" segments.
Inventoried Roadless Areas	13 inventoried roadless areas	These areas are managed to protect their roadless character. They include desired conditions to be relatively undisturbed and are important to biological diversity. Since no roads are to be built in these areas without significant rule, these areas reduce the risk of disturbance to at-risk species.
Management Area	Saguaro Wild Burro Management Area	(No significant effects expected)
Management Area	Apache Leap Special Management Area	(No significant effects expected)

Alternative A Effects

The no-action alternative would continue to rely on direction from the 1985 Tonto forest plan to "Provide a serviceable road and trail transportation system to meet public access, land management, and resource protection needs." Roads and access would continue to receive annual maintenance according to existing Forest budget and schedule, with a focus on maintenance levels that provide for user safety and protect investments and soil and water resources. Substandard roads would be closed, and opportunities for off-highway vehicle use would be commensurate with resource management objectives and budget levels.

Management Areas: Alternative A

Table 160. Effects of management areas in alternative A on facilities, roads, construction, and motorized access

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	Proposed areas include direction that prefers foot traffic over other forms of transportation and specifies that new trails (motorized and nonmotorized) should not be constructed. Logging is not permitted in these areas, decreasing construction and road risks associated with vegetation and timber management.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A – 6K	(No significant effects expected)

Effects Common to Alternatives B, C, D

All action alternatives provide substantial plan components that address potential negative impacts from facilities, roads, and construction. These include desired conditions, standards, and guidelines that direct programs to consider impacts to wildlife and their habitats. Desired conditions in all action alternatives strive for roads, trails, and construction activities that have few negative effects and recognize potential impacts on species and their habitats:

- RD-DC-04: National Forest System roads have minimal adverse environmental impacts to soil, riparian areas, watercourses, native vegetation, and at-risk species.
- REC-DIS-DC-06: Unauthorized user-created trails are not evident on the landscape.

There are also guidelines which direct projects and activities to avoid or mitigate impacts riparian and other sensitive habitats.

- RD-G-05: New or reconstructed roads should be located outside of the riparian management zone, or other important water resources (e.g., meadows, wetlands, seeps, and springs), in order to prevent resource damage. If road construction in riparian areas is unavoidable, it should be designed and implemented to minimize effects to natural waterflow, aquatic species, channel morphology, water quality, and native riparian vegetation. The number of stream crossings should be minimized to reduce negative impacts to natural resources.
- REC-G-04: Newly developed and dispersed recreation sites, facilities, and authorized activities should be designed and located in places so as not to degrade water quality, sensitive environments, or prevent wildlife access to water.

The action alternatives also direct the forest to decommission specified routes in an effort to reduce ecological impacts:

- RD-DC-05: Unauthorized routes are not apparent on the landscape.

- RD-G-03: Decommissioned roads should be returned to their natural condition.

Plan components also guide the design and construction of roads, facilities, and related infrastructure in order to avoid or minimize impacts:

- RD-G-06: New or redesigned stream crossings (e.g., bridges and culverts) should be wide enough to pass the bankfull without obstructing or confining the flow.
- RD-DC-06: Forest roads have a water drainage system that minimizes delivering sediment and pollutants to water bodies.
- RD-G-04: When designing or maintaining bridges, design elements that reduce mortality and are beneficial to wildlife (e.g., habitat connectivity, roost sites) should be incorporated.
- RD-G-09: When temporary roads are necessary, stream crossings should be designated to mitigate sedimentation and gradient changes and impacts to channel stability. These crossings should be designated by the appropriate resource specialists and installed and removed while protecting existing adjacent features.
- RD-G-07: New or reconstructed roads, culverts, and other water crossing infrastructure should be designed and located to allow for passage of aquatic species and the naturally occurring sediment and debris transported by the stream.

Plan components provide guidelines to minimize impacts while providing strategies how to accomplish this goal:

- RD-G-10: Reconstruction and rehabilitation of existing roads should be prioritized over new construction.
- EG-G-04: New energy facilities and transmission corridors should avoid locations in areas identified as having a demonstrated high risk to at-risk species, cultural resources, or other resources.
- FC-G-02: Construction of new facilities in sensitive environments (e.g., floodplains, wetlands) should be avoided or area of disturbance minimized, where practicable.

The vast majority of plan components related to roads, construction, and motorized access do not vary across action alternatives; however, some alternatives may indirectly affect these impacts and will be discussed further. For a complete list of plan components that address ecological conditions associated with facilities, roads, construction, and motorized access, and a crosswalk showing how plan components address threats from these activities, see appendix G in volume 4.

Alternative B Effects

Because this alternative proposes to use a combination of mechanical treatments, wildfire, and prescribed fire, it is also likely that this alternative will increase the number of temporary roads and landings commonly used in mechanical treatments. Future vegetation and timber projects that require such roads or other types of construction could pose a disturbance risk to species that are particularly at risk to these activities.

In addition, alternative B strives to create opportunities for recreation are managed to balance public demand and natural resource desired conditions. Specifically, it includes objectives to develop or modify 1 to 4 systems of sustainably designated motorized and nonmotorized trails (e.g., bike trails, equestrian trails, dirt bike, jeep, and all-terrain vehicle trails) within 10 years of plan approval. It also includes an objective to maintain to standard, with participation from volunteer efforts and/or collaboratives, motorized and nonmotorized trails on at least 30 percent of the forest's designated routes annually. This focus on provided access while protecting natural resources assumes a potential for new roads and trails (both motorized and nonmotorized).

While both motorized and nonmotorized trails may impact at-risk species and their habitats, motorized trails and vehicles are considered more impactful that nonmotorized trails and foot traffic. Because our analysis focuses on the greatest potential for negative impacts, in this alternative we consider the possibility that future actions move to develop and maintain only motorized roads and trails.

For species that are at sensitive to recreation activities, motorized roads and trails along with the accompanying vehicles can have substantial impacts. Under this alternative we would predict the negative impacts described in the effects common to alternatives B, C, D would apply to addition motorized routes and trails. The plan components outlined in these alternatives would be used to mitigate such impacts.

This alternative evaluates vacant allotments resulting in one of three outcomes (i.e., conversion to a forage reserve, granting to new permittee, or partial or whole closure). While it is unclear to what degree allotments make be used or unused under this alternative, we consider the potential that all currently vacant allotments remain open and are grazed. Under such a scenario, increased grazing may result in future construction activities related to range improvements (e.g., stock tanks, fences, windmills, motorized off-road travel) in previously vacant allotments. Overall, this alternative could lead to an increase in motorized use and range improvements that might increase the impacts described above.

Management Areas: Alternative B

Table 161. Effects of management areas in alternative B on facilities, roads, construction, and motorized access

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	Motorized and mechanized uses are only authorized if they do not permanently degrade wilderness characteristics. No new permanent or temporary roads are to be constructed in recommended wilderness. Recreation facilities should not be installed. Desired conditions for these areas aim to be essentially unmodified. While not as restrictive as designated wilderness areas, the overall direction for recommended wilderness suggests added layers of protection for species at risk from construction, roads, and motorized access.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Designated areas include direction that prefers foot traffic over other forms of transportation and specifies that new trails (motorized and nonmotorized) should not be constructed. Logging and fuelwood gathering is not permitted in these areas, decreasing construction and road risks associated with vegetation and timber management.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Designated areas include direction that prefers foot traffic over other forms of transportation and specifies that new trails (motorized and nonmotorized) should not be constructed. Logging and fuelwood gathering is not permitted in these areas, decreasing construction and road risks associated with vegetation and timber management.

Type of area	Name(s)	Effects
Management Area	Lakes and Rivers Management Area	The emphasis on recreation opportunity in this management area suggests a likelihood for future construction, roads, and motorized use. While much of this area has already been impacted by recreational uses, future management designed to accommodate growing use suggests that species sensitive to construction activities will have an increased risk over time.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Horse viewing is a popular activity on the lower Salt River. This activity likely contributes to the many recreation impacts already present in the area (e.g., human presence, motor vehicle traffic, foot traffic, etc.). While trends in horse-viewing as activity are difficult to project, we do not anticipate that designation of the management area will substantially affect vehicle or human traffic in the area. Any future construction projects related to the area (such as fencing, gating, or crossing) may have impacts to species, but are likely to be small in footprint and include design features that minimize impacts to species.

Alternative C Effects

The heavy emphasis on using prescribed burning as the primary tool to restore frequent fire systems would result in a comparative decrease in the number of construction activities associated vegetation and fuel treatments. Thus, this alternative may ultimately result in a lower risk of construction and road related impacts on at-risk species and habitats.

In this alternative, opportunities are managed to favor nonmotorized and primitive recreation. It includes objectives to develop or modify 2 to 8 systems of nonmotorized trails and maintain to standard 30 percent of designated, nonmotorized routes annually. Objectives to decommission routes (10 miles of unneeded every 5 years) would focus solely on motorized routes. This focus on opportunities that favor nonmotorized and primitive recreation assumes a potential for fewer roads and trails (both motorized and nonmotorized).

For species that are sensitive to motorized recreation, the focus on primitive recreation is likely to have some benefits. While nonmotorized trails and activities do have the potential disrupt some species and habitats, let are less likely to have the same level of disruption as motorized use.

This alternative closes vacant allotments and is likely to decrease the number of construction activities related to range improvements, or, at minimum is likely to decrease the motorized travel in allotments. Thus, this alternative results in a decreased risk for species sensitive to roads and construction.

Management Areas: Alternative C

Table 162. Effects of management areas in alternative C on facilities, roads, construction, and motorized access.

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	Motorized and mechanized uses are only authorized if they do not permanently degrade wilderness characteristics. No new permanent or temporary roads are to be constructed in recommended wilderness. Recreation facilities should not be installed. Desired conditions for these areas aim to be essentially unmodified. While not as restrictive as designated wilderness areas, the overall direction for recommended wilderness suggests added layers of protection for species at risk from construction, roads, and motorized access.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Designated areas include direction that prefers foot traffic over other forms of transportation and specifies that new trails (motorized and nonmotorized) should not be constructed. Logging and fuelwood gathering is not permitted in these areas, decreasing construction and road risks associated with vegetation and timber management.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Designated areas include direction that prefers foot traffic over other forms of transportation and specifies that new trails (motorized and nonmotorized) should not be constructed. Logging and fuelwood gathering is not permitted in these areas, decreasing construction and road risks associated with vegetation and timber management.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Horse viewing is a popular activity on the lower Salt River. This activity likely contributes to the many recreation impacts already present in the area (e.g., human presence, motor vehicle traffic, foot traffic, etc.). While trends in horse-viewing as activity are difficult to project, we do not anticipate that designation of the management area will substantially affect vehicle or human traffic in the area. Any future construction projects related to the area (such as fencing, gating, or crossing) may have impacts to species, but are likely to be small in footprint and include design features that minimize impacts to species.

Alternative D Effects

In this alternative, the primary reliance on mechanical treatments for restoring frequent fire systems may result in an increased risk of related construction activities. Generally, mechanically treated areas are then followed by fire in future treatments; however, this focus on using mechanically treated areas is likely to lead to repeated entry of machinery, resulting in more intense and longer-term exposure to species at risk from construction activities.

This alternative encourages motorized access, with objectives to develop or modify 2 to 8 systems of motorized trails and maintain to standard 30 percent of designated, motorized routes annually. Objectives to decommission routes (10 miles of unneeded routes every 5 years) would focus solely on nonmotorized routes. This focus on opportunities that favor motorized and accessible recreation presume the potential for more new roads and trails (both motorized and nonmotorized).

Because we considered the potential that alternative B might only focus on the development and maintenance of motorized roads and trails, the effects for alternative D are effectively the same as those describe in alternative B.

This alternative grants vacant allotments to new permittees. In turn, this is likely to result in additional range improvements, roads, or simply motorized travel in allotments. This type of increased use in allotments is likely to add to an increased risk for species sensitive to facilities, roads, and construction.

Management Areas: Alternative D

Table 163. Effects of management areas in alternative D on facilities, roads, construction, and motorized access

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	None	(No significant effects expected)
Management Area	Lakes and Rivers Management Area	The emphasis on recreation opportunity in this management area suggests a likelihood for future construction, roads, and motorized use. While much of this area has already been impacted by recreational uses, future management designed to accommodate growing use suggests that species sensitive to construction activities will have an increased risk over time.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. Horse viewing is a popular activity on the lower Salt River. This activity likely contributes to the many recreation impacts already present in the area (e.g., human presence, motor vehicle traffic, foot traffic, etc.). While trends in horse-viewing as activity are difficult to project, we do not anticipate that designation of the management area will substantially affect vehicle or human traffic in the area. Any future construction projects related to the area (such as fencing, gating, or crossing) may have impacts to species, but are likely to be small in footprint and include design features that minimize impacts to species.

Summary and Comparison of Effects

Alternative C is the most efficient alternative in reducing the negative impacts of facilities, roads, construction, and motorized access. The proposed management areas provide large areas where these impacts would be reduced or eliminated. To a lesser degree, the focus on nonnotarized access would likely be beneficial to species, though it is difficult to determine the scale of these objectives.

Alternative B and D would likely have similar impacts, but also contain numerous plan direction to implement mitigations and considerations at the project level, ultimately provide ecological conditions needed for at-risk species affected by this threat. Alternative A has little specific guidance to support at-risk species affected by roads, facilities, and motorized access.

Plan Components that Provide Ecological Conditions for At-risk Species

Table 164 describes threats to persistence associated with facilities, roads, construction, and motorized access for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 164. Plan components that address threats to at-risk species related to facilities, roads, construction, and motorized access

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
collisions with tall, man-made structures (towers, antennas, wind turbines)	Yellow-billed cuckoo		EG-G-04; FC-G-04; REC-G-03; REC-G-04; RD-G-05; WFP-G-06
construction activities	Milk Ranch Talussnail, Sierra Ancha talussnail	DWSRMA-DC-05; FC-DC-02	REC-DIS-G-03; FC-G-02; FC-G-03; RMZ-G-03; SU-S-03; WFP-G-06; WFP-G-08
road construction and maintenance	Blumer's dock, Colorado pikeminnow, fossil springsnail, loach minnow, ocelot, roundtail chub, Sierra Ancha talussnail	RD-DC-04; RD-DC-05; RD-DC-06	DWSRMA-G-01; REC-DIS-G-03; REC-DIS-G-04; EWSRMA-G-02; IRAMA-S-02; RWMA-S-01; RD-G-01; RD-O-01; RD-G-02; RD-S-02; RD-S-03; RD-G-03; RD-S-04; RD-G-05; RD-G-06; RD-G-07; RD-G-08; RD-G-10; RD-G-11; WAT-G-08; WFP-G-08

Pesticides and Pollutants

Affected Environment

Generally, most pollution that occurs on the forest comes from nonpoint sources including mining, livestock grazing, roads, timber and fuelwood harvesting, impoundments, recreational uses, and ground disturbance created by off-highway-vehicle use. Potential point sources for pollution include wastewater facilities associated with campgrounds, administrative sites, and other sites authorized by special use permits (e.g., fish hatcheries, marinas), and current and historic mines.

The Forest also has a program for treating invasive species that involves the use of pesticides. The program is conducted under the guidance of the Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants Tonto National Forest: Gila, Maricopa, Pinal, and Yavapai Counties, Arizona (USDA Forest Service 2012b). There are guidelines for authorized uses of different treatment methodologies, specific mitigation measures for special areas, and general best management practices.

Table 165. At-risk species that may be negatively impacted by pesitcides or pollutants

Common Name	Scientific name	Taxonomic group	At-risk species status
Chiricahua leopard frog	*Lithobates chiricahuensis*	amphibian	threatened
Colorado pikeminnow	*Ptychocheilus lucius*	fish	endangered, experimental population, non-essential
Milk Ranch Talussnail	*Sonorella micromphala*	invertebrate	species of conservation concern
Monarch butterfly	*Danaus plexippus*	invertebrate	species of conservation concern

Common Name	Scientific name	Taxonomic group	At-risk species status
Sierra Ancha talussnail	*Sonorella anchana*	invertebrate	species of conservation concern

Effects Common to All Alternatives

Under all alternatives, risks from pesticides and pollutants are expected to improve as watershed conditions improve. Rangeland utilization standards, watershed restoration projects, fuel treatments, and road decommissioning are all expected to help address this threat (see Watershed and Water Resources section for more details). Point sources of pollution (e.g., mining and recreation sites) are likely to remain threat at a local scale.

Management Areas Common to All Alternatives

Table 166. Effects of management areas on pesticides and pollutants.

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	Due to the emphasis on low human disturbance and impacts, along with restrictions on motorized access, these areas are likely to be beneficial for species at risk of pesticides and pollutants.
Designated Wild and Scenic Rivers	Fossil Creek and Verde River	Disposal of saleable mineral materials should not be authorized within river corridors with “scenic” or “recreational” designation. Existing or new mining activity on an identified eligible river must be conducted in a manner that minimizes surface disturbance, sedimentation, pollution, and visual impairment. Leasable minerals must include conditions necessary to protect the values of the river corridor that make it eligible for inclusion in the National System.
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(no significant effect expected)
Significant Caves	17 significant caves (see forest plan for more info)	(no significant effect expected)
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	In eligible segments, existing or new mining activity must be conducted in a manner that minimizes surface disturbance, sedimentation, pollution, and visual impairment, protecting the values of the river corridor. Disposal of saleable mineral materials is prohibited for “wild” classification, and for “scenic” and “recreational” classifications, allowed if the values of the river corridor that make it eligible for inclusion in the National System are protected.
Inventoried Roadless Areas	13 inventoried roadless areas	The purpose of this area includes protecting watersheds from pollution, thus inventoried roadless areas are likely beneficial in protecting species from pesticides and pollutants.
Management Area	Saguaro Wild Burro Management Area	(no significant effect expected)

Type of area	Name(s)	Effects
Management Area	Apache Leap Special Management Area	(no significant effect expected)

Alternative A Effects

Unlike alternatives B and C, alternative A does not include specific guidance regarding mineral materials (e.g., sand and gravel) in riparian management zones. While such guidance is considered beneficial for the many species that depend on riparian and aquatic habitats, it is unclear what the future demand might be for such materials. While the existing plan (alternative A) does include direction to prioritize riparian restoration and related objectives, it is less clear on how what aspects to prioritize and protect than the riparian and aquatic direction proposed in alternatives B, C, and D, which include standards and guidelines to guide projects in the riparian management zone.

Management Areas: Alternative A

Table 167. Effects of management areas in alternative A on pesticides and pollutants

Type of area	Name(s)	Effects
Recommended Wilderness	None	Recommended wilderness areas are valued by the public and contribute to clean air and water The environment within recommended wilderness areas is essentially unmodified Restrictions on motorized and mechanized access, new or temporary roads and trails, timber harvest, energy developments, and sales or extraction of common variety minerals all reduced the potential for pollutants and pesticides Additional criteria for active weed management
Proposed Botanical Areas	None	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas. Recreational shooting will not be authorized within designated or proposed botanical areas.
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas. Recreational shooting will not be authorized within designated or proposed botanical areas.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A-6K	(no significant effect expected)

Effects Common to Alternatives B, C, D

All action alternatives contain plan direction that addresses concerns from pesticides and pollutants. These include desired conditions that describe habitats as generally free from substantial impacts from pollutants. These desired conditions also apply to resources uses where risks of pollution are present (e.g., mineral exploration):

- WAT-DC-02: Surface water and groundwater quality, meets or exceeds applicable state water quality standards, fully supports designated beneficial uses, maintains or moves ecological conditions to low departure from reference conditions and meets the needs of downstream water users.
- AQ-DC-03: Water chemistry and biotic components are not negatively impacted by atmospheric deposition of pollutants.
- MMAM-DC-01: Mining and mineral activities comply with law, regulation, and policy in the development of minerals in a manner that minimizes adverse environmental impacts to surface and groundwater resources, watershed and forest ecosystem health, wildlife and wildlife habitat, scenic character, and other desired conditions applicable to the area.

Desired conditions for filtering.

- RMZ-DC-02: Within their type and capability, riparian areas protect and enrich soils, stabilize banks and shorelines, and improve water quality by filtering and capturing sediment, filtering contaminants, and dissipating stream energy from flows.

Infrastructure and transport

- RD-DC-06: Roads have a water drainage system that minimizes delivering sediment and pollutants to water bodies.
- WAT-S-01: Project-specific best management practices (BMPs) shall be incorporated in land use and project plans as a principal mechanism for controlling non-point pollution sources, to meet soil and watershed desired conditions, and to protect beneficial uses.

Plan components also specify activities that should be avoided or mitigated in important or sensitive habitats. Direction also guides the design of projects to address the risks of pollution:

- INS-G-05: If chemical application is necessary near human developments (e.g., developed recreation sites) or ecologically sensitive habitat (e.g., at-risk species and riparian areas), techniques should be applied to minimize negative effects (e.g., chemical-free buffers, and spot treatments).
- RMZ-S-02: Refueling, maintaining equipment, and storing fuels or other toxicants shall not occur in riparian management zones, except in the Lakes and Rivers Management Area.
- REC-G-04: Newly developed and dispersed recreation sites, facilities, and authorized activities should be designed and located in places so as not to degrade water quality, sensitive environments, or prevent wildlife access to water.
- WAT-G-05: Activities that could impact groundwater or surface water quality should be located outside Source Water Protection Areas to prevent potential impacts.

Generally, this guidance does not change appreciably between alternatives, though other aspects of the alternatives may vary in how they contribute to pesticide and pollution risks.

For a complete list of plan components that address ecological conditions associated with mining impacts, and a crosswalk showing how plan components address species-specific threats related to recreation, see appendix G in volume 4.

Alternative B Effects

In the proposed action (alternative B), opportunities for recreation are managed to balance public demand and natural resource desired conditions. Specifically, it includes objectives to develop or modify 2 to 8 systems of sustainably designated motorized and nonmotorized trails (e.g., bike trails, equestrian trails, dirt bike, jeep, and all-terrain vehicle trails) within 10 years of plan approval. It also includes an objective to maintain to standard, with participation from volunteer efforts and/or collaboratives, motorized and nonmotorized trails on at least 30 percent of the forest's designated routes annually. This focus on provided access while protecting natural resources assumes a potential for new roads and trails (both motorized and nonmotorized).

Generally, motorized roads and trails are assumed to have a greater impact on pollution (specifically erosion and sedimentation) than smaller, nonmotorized trials. However, due to range of trail types (motorized versus nonmotorized) that could developed or modified, it is unclear which trail type is likely to be the focus of future projects under this alternative.

For current purposes, we will consider impacts for the greatest potential, negative impact. Should management result in additional motorized road and trail systems, this is likely to negatively impact erosion and sedimentation, resulting in additional risk to species threatened by pollutants. Such negative impacts may be mitigated, in part, by the objective to maintain these roads and trails to standard. An overall increase in motorized access over time is likely to have a negative impact on species threatened by pollutants.

Alternative B also includes a guideline directing that mineral materials should not be removed from the riparian management zone without adequate engineering controls to protect surface waters. While the scale and impact of current or future projects related to such materials is unclear, this specific direction would likely be beneficial when planning and implementing such projects in the riparian management zone. It calls attention to an activity that does have the potential to cause significant erosion and sedimentation, and possibility other pollution sources related to mining equipment, and directs mitigation measures in vital plant and wildlife habitat.

Management Areas: Alternative B

Table 168. Effects of management areas in alternative B on pesticides and pollutants

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	These areas are valued by the public and contribute to clean air and water The environment within recommended wilderness areas is essentially unmodified Restrictions on motorized and mechanized access, new or temporary roads and trails, timber harvest, energy developments, and sales or extraction of common variety minerals all reduced the potential for pollutants and pesticides Additional criteria for active weed management
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas.
Management Area	Lakes and Rivers Management Area	(no significant effect expected)

Type of area	Name(s)	Effects
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. The presence horses can lead to surface and groundwater pollution, primarily in the form of organic matter, excess nutrients, and pathogen contamination.

Alternative C Effects

In this alternative, opportunities are managed to favor nonmotorized and primitive recreation. It includes objectives to develop or modify 2 to 8 systems of nonmotorized trails and maintain to standard 30 percent of designated, nonmotorized routes annually. Objectives to decommission routes (10 miles of unneeded every 5 years) would focus solely on motorized routes. This focus on opportunities that favor nonmotorized and primitive recreation assumes a potential for fewer roads and trails (both motorized and nonmotorized).

Since motorized roads and trails (and the vehicles associated with them) likely have a greater impact on erosion and sedimentation than smaller, nonmotorized trails, the emphasis on nonmotorized access is considered more beneficial for species threatened by pollution.

Potential negative impacts from nonmotorized trails are likely to be mitigated, in part, by the objective to maintain these trails to standard. However, a focus on maintaining nonmotorized trails may lead to less work motorized routes that are ultimately more impactful.

Fewer roads and trails over time is likely to have a net positive effect on erosion and sedimentation, benefiting species at risk from this form of pollution. Focusing efforts to decommission unneeded motorized trails is likely to be more beneficial than decommissioning nonmotorized routes as proposed in alternative C.

Alternative C includes a standard that mineral materials (e.g., sand and gravel) shall not be removed from the riparian management zone. While the scale and impact of current or future projects related to such materials is unclear, this specific direction would likely be beneficial when planning and implementing such projects in the riparian management zone. It directly prohibits and an activity that has the potential to cause significant erosion and sedimentation, and possibility other pollution related to mining equipment. As with many types of ground disturbing projects, a direct prohibition of mineral material mining in sensitive riparian management zones is likely to convey the most benefits to at-risk species in these habitat types; however, we acknowledge that this particular activity may not be a primary threat to species at risk of pollution or pesticides.

Management Areas: Alternative C

Table 169. Effects of management areas in alternative C on pesticides and pollutants

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	Recommended wilderness areas are valued by the public and contribute to clean air and water The environment within recommended wilderness areas is essentially unmodified Restrictions on motorized and mechanized access, new or temporary roads and trails, timber harvest, energy developments, and sales or extraction of common variety minerals all reduced the potential for pollutants and pesticides Additional criteria for active weed management
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas. Recreational shooting will not be authorized within designated or proposed botanical areas.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Sales or extraction of common variety minerals shall not be permitted in designated or proposed research natural areas or botanical areas. Recreational shooting will not be authorized within designated or proposed botanical areas.
Management Area	None	(no significant effect expected)
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. The presence horses can lead to surface and groundwater pollution, primarily in the form of organic matter, excess nutrients, and pathogen contamination.

Alternative D Effects

This alternative encourages motorized access, with objectives to develop or modify 2 to 8 systems of motorized trails and maintain to standard 30 percent of designated, motorized routes annually. Objectives to decommission routes (10 miles of unneeded routes every 5 years) would focus solely on nonmotorized routes. This focus on opportunities that favor motorized and accessible recreation presume the potential for more new roads and trails (both motorized and nonmotorized).

Because motorized trails are generally larger than nonmotorized trails, and because motorized vehicles have a generally larger footprint, an emphasis on motorized access is more likely to increase the risks associated from pollution, particularly from erosion and sedimentation, when compared to other alternatives. Some of the potential negative effects from such roads and motorized routes would be mitigated with the increased focus on road maintenance.

Because of the many user-created, motorized routes currently found on the forest, it is likely that any new roads or motorized trails added to the system as part of this alternative may come from these user-created routes. In such cases the impact is likely to be relatively low compared to the impacts of entirely new road or trail systems in previously undisturbed. Objectives to decommission nonmotorized trails is probably less impactful here than in other alternatives (B and C) where motorized routes are also or primarily decommissioned over time.

Unlike alternatives B and C, alternative D does not include specific guidance regarding mineral materials (e.g., sand and gravel) in riparian management zones. While such guidance is considered beneficial for the many species that depend on riparian and aquatic habitats, it is unclear what the future demand might be for such materials. We expect that, even if not called out specifically called out as a standard or guideline, other plan content regarding the treatment riparian and aquatic habitats and species is likely to compel mitigation measures for future projects in the riparian management zone; thus, we do not expect a substantial effect on the persistence of species threatened by such activities.

Management Areas: Alternative D

Table 170. Effects of management areas in alternative D on pesticides and pollutants.

Type of area	Name(s)	Effects
Recommended Wilderness	None	(no significant effect expected)
Proposed Botanical Areas	None	(no significant effect expected)
Proposed Research Natural Areas	None	(no significant effect expected)
Management Area	Lakes and Rivers Management Area	(no significant effect expected)
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. The presence horses can lead to surface and groundwater pollution, primarily in the form of organic matter, excess nutrients, and pathogen contamination.

Summary and Comparison of Effects

Alternative C is considered to most efficient alternative in addressing threats from pollution and pesticides. Through management areas and plan direction that emphasizes nonmotorized recreation, it likely improves watershed health and slows the transport of pollutants. It also reduces the potential for invasions of nonnative species that might be treated with pesticides. Finally, added language to protect riparian management zones could benefit the aquatic species impacted by pollution from sediments and man-made chemicals.

Plan Components that Provide Ecological Conditions for At-risk Species

The following table describe threats to persistence associated with pesticides and pollutants for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 171. Plan components that address threats to at-risk species related to pesticides and pollutants

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
pesticides or other pollutants	Chiricahua leopard frog, Colorado pikeminnow, Milk Ranch Talussnail, monarch butterfly, Sierra Ancha talussnail	AQ-DC-03; RD-DC-06	INS-G-01; INS-G-05; WAT-S-01; WAT-G-05

Rare endemics, Small Populations, and Restricted Distribution

Affected Environment

The Tonto National Forest is home to a number of rare and endemic species, and while they contribute greatly to the diversity of flora and fauna in the region, many of these species also face particular challenges associated with rarity. This section does not necessarily address the root causes of rarity in species; generally, the ecological conditions affecting at-risk species are addressed in previous sections. For many at-risk species on the Tonto National Forest, the causes of such rarity is unknown, hypothetical, or due to circumstances not within the inherent capability of the plan area. Rather, we examine the effects and differences in the programmatic direction to protect rare, endemic species on the forest and the potential impacts of management areas on such species where they occur, regardless of the specific threat to persistence.

Table 172. At-risk species that may be affected by stochastic risks associated with rare endemism, small populations, and restricted distribution

Common Name	Scientific name	Taxonomic group	At-risk species status
A mayfly	*Fallceon eatoni*	invertebrate	species of conservation concern
American dipper	*Cinclus mexicanus*	bird	species of conservation concern
Ancha mountainsnail	*Oreohelix anchana*	invertebrate	species of conservation concern
Aravaipa sage	*Salvia amissa*	plant	species of conservation concern
Arizona bugbane	*Cimicifuga arizonica* (syn. *Actaea arizonica)*	plant	species of conservation concern
Arizona cliffrose	*Purshia subintegra*	plant	endangered
Arizona giant sedge (syn. Cochise sedge)	*Carex ultra*	plant	species of conservation concern
Arizona hedgehog cactus	*Echnocereus triglochidiatus* var. *arizonicus*	plant	endangered
Bezy’s night lizard	*Xantusia bezyi*	reptile	species of conservation concern
Blumer's dock	*Rumex orthoneurus*	plant	species of conservation concern

Common Name	Scientific name	Taxonomic group	At-risk species status
Broadleaf lupine	*Lupinus latifolius* ssp. *Leucanthus*	plant	species of conservation concern
Chiricahua leopard frog	*Lithobates chiricahuensis*	amphibian	threatened
Colorado pikeminnow	*Ptychocheilus lucius*	fish	endangered, experimental population, non-essential
Davidson sage	*Salvia davidsonii*	plant	species of conservation concern
Desert pupfish	*Cyprindon macularius*	fish	endangered
Fish Creek fleabane	*Erigeron piscaticus*	plant	species of conservation concern
Fish Creek rock daisy	*Perityle saxicola*	plant	species of conservation concern
Flagstaff Beardtongue	*Penstemon nudiflorus*	plant	species of conservation concern
Fossil springsnail	*Pyrgulopsis simplex*	invertebrate	species of conservation concern
Gila chub	*Gila intermedia*	fish	endangered
Gila rock daisy	*Perityle gilensis* var. *gilensis*	plant	species of conservation concern
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	fish	endangered
Gila trout	*Oncorhynchus gilae*	fish	threatened
Gilded flicker	*Colaptes chrysoides*	bird	species of conservation concern
Grand Canyon century plant	*Agave phillipsiana*	plant	species of conservation concern
Hodgson's fleabane	*Erigeron hodgsoniae*	plant	species of conservation concern
Hohokam agave	*Agave murpheyi*	plant	species of conservation concern
Horseshoe deer vetch	*Lotus mearnsii* var. *equisolensis*	plant	species of conservation concern
James' rubberweed	*Hymenoxys jamesii*	plant	species of conservation concern
Loach minnow	*Tiaroga cobitis*	fish	endangered
Lowland leopard frog	*Lithobates yavapaiensis*	amphibian	species of conservation concern
Mapleleaf false snapdragon	*Mabrya acerifolia*	plant	species of conservation concern
Marsh rosemary	*Limonium limbatum*	plant	species of conservation concern
Metcalfe's tick-trefoil	*Desmodium metcalfei*	plant	species of conservation concern
Milk Ranch Talussnail	*Sonorella micromphala*	invertebrate	species of conservation concern
Monarch butterfly	*Danaus plexippus*	invertebrate	species of conservation concern
Mt. Dellenbaugh sandwort	*Eremogone aberrans* syn. *Arenarwia aberrans)*	plant	species of conservation concern
Narrow-headed gartersnake	*Thamnophis rufipunctatus*	reptile	threatened
Net-winged midge	*Agathon arizonicus*	invertebrate	species of conservation concern
Ocelot	*Leopardus pardalis*	mammal	endangered
Pacific wren	*Troglodytes pacificus*	bird	species of conservation concern
Pringle's fleabane	*Erigeron pringlei*	plant	species of conservation concern
Razorback sucker	*Xyrauuchen texanus*	fish	endangered
Ripley wild buckwheat	*Eriogonum ripleyi*	plant	species of conservation concern

Common Name	Scientific name	Taxonomic group	At-risk species status
Roundtail chub	*Gila robusta*	fish	species of conservation concern
Rusby's milkwort	*Polygala rusbyi* (syn. *Rhinotropis rusbyi)*	plant	species of conservation concern
Salt River rock daisy	*Perityle gilensis* var. *salensis*	plant	species of conservation concern
Senator Mine alumroot	*Heuchera eastwoodiae*	plant	species of conservation concern
Sierra Ancha fleabane	*Erigeron anchana*	plant	species of conservation concern
Sierra Ancha talussnail	*Sonorella anchana*	invertebrate	species of conservation concern
Sonoran maiden fern	*Thelypteris puberula* var. *sonorensis*	plant	species of conservation concern
Southwestern willow flycatcher	*Empidonax traillii extimus*	bird	endangered
Spikedace	*Meda fulgida*	fish	endangered
Tonto Basin agave	*Agave delamateri*	plant	species of conservation concern
Toumey groundsel	*Packera neomexicana* var. *toumeyi*	plant	species of conservation concern
Verde Rim springsnail	*Pyrgulopsis glandulosa*	invertebrate	species of conservation concern
Western red bat	*Lasiurus blossevilli*	mammal	species of conservation concern
Yellow-eyed junco	*Junco phaeonotus*	bird	species of conservation concern
Yuma Ridgeway's rail	*Rallus obsoletus yumanensis*	bird	endangered

Effects Common to All Alternatives

While rarity of itself is not necessarily a risk factor (most species are relatively rare while a few species are common), the species covered in this section were identified as at risk due to issues associated with rarity. Small populations increase the possibility that any given stochastic disturbance could drastically reduce the total number of individuals. Many rare species are associated with very specific habitat features, the alternative of which may have a disproportional impact on the population. Rare species are often distributed unevenly across the landscape and may reproductively isolated, making them more susceptible to a loss of genetic diversity (i.e., inbreeding, genetic drift, unfavorable mutations).

While some species in this analysis are considered rare due to known impacts from habitat loss or human activities, many are rare for largely unknown reasons. In either case, these species are likely to face a variety of risks under all alternatives.

Management Areas Common to All Alternatives

Table 173. Effects of management areas on rare species

Type of area	Name(s)	Effects
Designated Wilderness	Four Peaks, Hellsgate, Mazatzal, Pine Mountain, Salome, Salt River Canyon, Sierra Ancha, and Superstition	The desired conditions in wilderness call for natural ecologic processes, and restrictions on human developments and motorized/mechanized intrusions, which is likely to provide protection for rare species and small populations. As discussed in the fire section of this report, the same restrictions on motorized access and building roads generally preclude mechanical treatments. This suggests that in wilderness areas with departed fire regimes may have an increased risk for rare species.
Designated Wild and Scenic Rivers	Fossil Creek and Verde River	Plan direction for designated river segments suggest that these areas are likely to afford an added layer of protection for rare species, especially in those segments designated as “wild” or “scenic.” Projects that occur in designated river segments are likely to improve or enhance and protect habitat.
Designated Research Natural Areas	Buckhorn Mountain, Bush Highway, and Haufer Wash	Plan direction is likely to lead to increased consideration for the needs of rare species and the ecological conditions needed to support these species. Plan components also include additional criteria for conducting some activities (e.g., grazing and recreation) that could lead to disturbance of rare species.
National Trails	Arizona National Scenic Trail, Great Western National Millennium Trail, Highline National Recreation Trail, and Six Shooter Canyon National Recreation Trail	(No significant effects expected)
Significant Caves	17 significant caves (see forest plan for more info)	Continuing management of significant caves is likely to contribute the ecological conditions needed by some rare species (especially bats) that use these features. Direction to secure and keep information on significant caves from the general public is likely to reduce disturbance to species in these habitats.
Eligible Wild and Scenic Rivers	19 eligible wild and scenic river segments	As in the case of designated river segments, Plan direction for eligible wild and scenic rivers suggest that these areas are likely to afford an added layer of protection for rare species, especially in those segments designated as “wild” or “scenic.” Projects that occur in eligible wild and scenic river segments are likely to improve or enhance and protect habitat.

Type of area	Name(s)	Effects
Inventoried Roadless Areas	13 inventoried roadless areas	Direction that prohibits motorized access and building of roads is likely to decrease the potential for disturbance (e.g., motorized recreation, construction, invasive species vectored by roads, etc.) to rare species. As will designated and recommended wilderness, one exception is the risk of fire which may remain higher in these areas due to the preclusion of mechanical treatments.
Management Area	Saguaro Wild Burro Management Area	(No significant effects expected)
Management Area	Apache Leap Special Management Area	(No significant effects expected)

Alternative A Effects

Much of the direction for wildlife in the 1985 forest plan is species specific and only pertains to small management areas. While some species have very specific protection measures outlined, most do not. The plan does not include direction for species of conservation concern. The 1985 plan does state that habitat requirements for threatened, endangered, and sensitive species will take precedence over requirements for other species; however, there is little direction to protect rare species where they occur. Also, this direction applies to particular management areas.

Under this alternative, there is little direction on addressing rare species, other than those listed as threatened, endangered, or regional forester sensitive species. Because there is substantial overlap between regional forester sensitive species and its replacement framework of species of conservation concern, many rare species are at least prioritized and addressed in some way under the current plan. However, specific plan components that provide the ecological conditions for these species are not included in the no-action alternative.

Management Areas: Alternative A

Table 174. Effects of management areas in alternative A on rare species

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	As with designated research natural area, proposed research natural areas contain plan direction is likely to lead to increased consideration for the needs of rare species and the ecological conditions needed to support these species. Plan components also include additional criteria for conducting some activities (e.g., grazing and recreation) that could lead to disturbance of rare species.
Management Area	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area, in addition to management areas 1A-6K	(No significant effects expected)

Effects Common to Alternatives B, C, D

Alternatives B, C, and D provide specific plan components to guide the protection of rare species with small populations. Such direction includes desired conditions that maintain unique communities and landscape features and encourage the forest to perpetuate better understanding of the location, status, and life history (e.g., population trend, threats, and habitat requirements) of at-risk, rare, and endemic species. There is also direction to protect sensitive areas that harbor rare species. This direction does not vary among the action alternatives.

All action alternatives call for habitats and other ecological conditions that sustain viable populations of at-risk species. In some instances, they identify specific habitat associations that merit particular attention:

- WFP-DC-01: Ecological conditions contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, maintain viable populations of species of conservation concern, and sustain both common and uncommon native species.
- WFP-DC-03: Habitat quality, distribution, and abundance contribute to self-sustaining populations of plant and animal species, including at-risk species.
- WFP-DC-08: Unique plant communities and landscape features (e.g., limestone cliffs, calcareous soils, margins of seeps and springs, canyons/cliffs, hanging gardens) are present to maintain well-distributed populations of associated native, endemic and rare plant species. Locally endemic plant communities are intact and functioning.

One of the greatest challenges to many rare species on the Tonto National Forest is an extreme lack of knowledge regarding them. For many newly identified species of conservation concern, little institutional knowledge is available and occurrence data is outdated. The action alternatives call for a program that works to resolve these knowledge gaps where possible:

- WFP-DC-06: Locations, status, and life histories (e.g., population trend, threats, and habitat requirements) of at-risk, rare, and endemic species are known and understood.

- WFP-G-03: The best available science and/or conservation measures should be used to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, maintain viable populations of species of conservation concern.

Plan components in the action alternatives direct considerations and mitigations during project design and implementation that consider rare populations and important life history events where they are known. They also guide managers to employ conservation agreements and recovery plans where available:

- WFP-G-01: Activities occurring within federally-listed species habitat should apply habitat management objectives and species protection measures from approved recovery plans.
- WFP-G-04: Projects and activities that may negatively impact at-risk species should consider protections and mitigation measures, especially considering the timing and location of vulnerable life history processes (e.g., reproduction, molting, migration, and hibernation). Examples of mitigations and protections could include but are not limited to: Timing restrictions, adaptive percent utilization levels, distance buffers.
- WFP-G-05: Projects and activities that may negatively impact or impair the viability of at-risk plant populations should be avoided where these species are known or likely to occur.
- WFP-G-09: Projects and activities that may negatively impact Sonoran desert tortoises should apply mitigations from the Arizona Interagency Desert Tortoise Team's Recommended Standard Mitigation Measures (or similar current guidance) when designing projects in desert tortoise habitat.
- FF-G-04: Temporary fire facilities (e.g., incident bases, camps, staging areas, helispots, and retardant batch plants) should be placed to avoid negative impacts in potentially sensitive species areas (e.g., designated critical habitat, owl packs, at-risk plant sites, and riparian areas).

With regard to rare plants, plan components preclude permitting collection and uses that might threaten these species:

- FP-G-07: Collection permits should not be authorized for rare plant species and/or Species of Conservation Concern if the species cannot withstand collection and if the collection will result in significant negative impacts to populations on the forest. Collection requests should be considered when the results of the research will aid management of the collected species and for traditional Tribal uses.

For a complete list of plan components that address ecological conditions associated with rare endemics, small populations, and restricted distributions, and a crosswalk showing how plan components address species-specific threats related to these issues associated with rarity, see appendix G, volume 4.

Alternative B Effects

Impacts from plan components in alternative B are similar to alternatives C and D.

Management Areas: Alternative B

Table 175. Effects of management areas in alternative B on rare species

Type of area	Name(s)	Effects
Recommended Wilderness	About 43,204 acres	Similar to designated wilderness, the desired conditions in recommended wilderness call for natural ecologic processes and restrictions on human developments and motorized/mechanized intrusions, which is likely to provide protection for rare species and small populations. As discussed in the fire section of this report, the same restrictions building roads generally preclude mechanical treatments. This suggests that in recommended wilderness areas with departed fire regimes may have an increased risk for rare species.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Plan direction in proposed botanical areas was developed in part to preserve rare, endemic species (especially plants). As such, much of the content seeks to minimize the impacts of authorized activities and preserve the ecological function of the area. These desired conditions for these areas suggest that future projects will likely be developed to preserve rare species within them.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Plan direction for proposed research natural areas is similar to proposed botanical areas (though with fewer restrictions The areas set aside are generally prime examples of their respective ecosystems and the preservation of their special values is likely to contribute to the viability of rare species.
Management Area	Lakes and Rivers Management Area	The focus on providing for recreation in this area may increase the risk of disturbance to small populations of rare species. Concentrated recreation and accompanying improvements can alter species habitat and behaviors, and may result in direct mortality (i.e., trampling or roadkill). Such effects can be disproportionally large to rare species. Much of this area is already impacted by heavy recreation, thus the impacts to this area apply primarily to the accommodation of expected growth in recreation use.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. While at-risk species may use the Salt River Horse Management Area (e.g., monarch butterfly), we are unaware of any species that is restricted to this area. Thus, we do not expect designation of the area to have substantial effects to species at risk due to rarity or restricted distributions.

Alternative C Effects

Impacts from plan components in alternative C are similar to alternatives B and D.

Management Areas: Alternative C

Table 176. Effects of management areas in alternative C on rare species

Type of area	Name(s)	Effects
Recommended Wilderness	About 399,029 acres	Similar to designated wilderness, the desired conditions in recommended wilderness call for natural ecologic processes and restrictions on human developments and motorized/mechanized intrusions, which is likely to provide protection for rare species and small populations. As discussed in the fire section of this report, the same restrictions building roads generally preclude mechanical treatments. This suggests that in recommended wilderness areas with departed fire regimes may have an increased risk for rare species.
Proposed Botanical Areas	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Plan direction in proposed botanical areas was developed in part to preserve rare, endemic species (especially plants). As such, much of the content seeks to minimize the impacts of authorized activities and preserve the ecological function of the area. These desired conditions for these areas suggest that future projects will likely be developed to preserve rare species within them.
Proposed Research Natural Areas	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Plan direction for proposed research natural areas is similar to proposed botanical areas (though with fewer restrictions The areas set aside are generally prime examples of their respective ecosystems and the preservation of their special values is likely to contribute to the viability of rare species.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. While at-risk species may use the Salt River Horse Management Area (e.g., monarch butterfly), we are unaware of any species that is restricted to this area. Thus, we do not expect designation of the area to have substantial effects to species at risk due to rarity or restricted distributions.

Alternative D Effects

Impacts from plan components in alternative D are similar to alternatives B and C.

Management Areas: Alternative D

Table 177. Effects of management areas in alternative D on rare species

Type of area	Name(s)	Effects
Recommended Wilderness	None	(No significant effects expected)
Proposed Botanical Areas	None	(No significant effects expected)

Type of area	Name(s)	Effects
Proposed Research Natural Areas	None	(No significant effects expected)
Management Area	Lakes and Rivers Management Area	The focus on providing for recreation in this area may increase the risk of disturbance to small populations of rare species. Concentrated recreation and accompanying improvements can alter species habitat and behaviors, and may result in direct mortality (i.e., trampling or roadkill). Such effects can be disproportionally large to rare species. Much of this area is already impacted by heavy recreation, thus the impacts to this area apply primarily to the accommodation of expected growth in recreation use.
Management Area	Salt River Horse Management Area	The Salt River Horses are found primarily along the lower Salt River and are the responsibility of the Arizona Department of Agriculture. The establishment of Salt River Horse Management Area is likely to result in a mix of effects for species present in the area (primarily low desert species or those associated with the Salt River riparian area). Management of the area puts physical boundaries on the herd, thus containing the animals and restricting the potential footprint of adverse effects. While at-risk species may use the Salt River Horse Management Area (e.g., monarch butterfly), we are unaware of any species that is restricted to this area. Thus, we do not expect designation of the area to have substantial effects to species at risk due to rarity or restricted distributions.

Summary and Comparison of Effects

Generally, programmatic direction for addressing the needs of rare species does not vary across action alternatives. Proposed direction the action alternatives recognizes the need for better understanding of rare endemics and helps protect species at a site-specific level. Alternatives B and C both include similar proposed botanical and research natural areas that are likely to provide safe havens for rare species; however, alternative C contributes substantially more recommended wilderness than alternative B. While recommended wilderness is considered largely beneficial for rare species, it may make fire management more challenging. As such, the net benefit of these areas for rare species is unclear and depends on the risk of fire in each propose area and the sensitivity of each species to fire effects. In addition, alternative B includes the Lakes and Rivers Management Area which prioritizes recreation opportunities. While this focus is likely negative for rare species, the current condition of the already impacted area suggests that additional effects may not be significant. Ultimately, alternatives B and C have many similarities and, while the effects of special areas may vary somewhat, both alternatives provide direction that provides conditions for rare species.

Alternative D differs from B and C primarily because it does not include recommended wilderness, proposed botanical and research natural areas. However, the plan content in all action alternatives (including D) regarding rare species is likely to contribute to the viability of at-risk species.

The no-action alternative (A) does call for specific actions for some named species considered rare or that exist in small populations; however, the actions are often specific to particular management areas and are not flexible and do not incorporate emerging science and management practices. The direction also only applies to a small subset of species considered to be at risk due to rarity. While the plan does call for some management areas to prioritize sensitive species habitat, many species may not be adequately addressed in the 1985 forest plan.

Plan Components that provide ecological conditions for at-risk species

Table 178 describe threats to persistence associated with rare endemics, small populations, and restricted distribution for each at-risk species and identified plan components which provide the ecological conditions necessary to 1) maintain a viable population of each species of conservation concern in the plan area, or 2) contribute to the recovery of federally listed species. These ecological conditions may be those provided for through a coarse filter approach (ecosystem integrity emphasis) or through a fine filter (species-specific) approach.

Table 178. Plan components that address threats to at-risk species related to rare endemics, small populations, and restricted distribution

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
declining population	Blumer's dock, fringed myotis, gilded flicker, Hohokam agave, lowland leopard frog, monarch butterfly, roundtail chub, Tonto Basin agave	RERU-DC-01; ERU-DC-14; WFP-DC-01; WFP-DC-04; WFP-DC-06	FP-G-09; WFP-O-01; WFP-G-01; WFP-G-03; WFP-G-05
disjunct populations	Net-winged midge, Ripley wild buckwheat	WFP-DC-02; WFP-DC-04; WFP-DC-05; WFP-DC-08	WFP-G-03; WFP-G-04; WFP-G-05; WFP-G-07; WFP-G-08; WFP-G-09
highly endemic	Bezy's night lizard, Flagstaff Beardtongue, fossil springsnail	WFP-DC-01; WFP-DC-02; WFP-DC-03; WFP-DC-04; WFP-DC-05; WFP-DC-06; WFP-DC-07; WFP-DC-08	FP-G-07; FP-G-09; WFP-O-02; WFP-G-03; WFP-G-04; WFP-G-05
lack of information necessary for effective conservation	James' rubberweed, Mt. Dellenbaugh sandwort, net-winged midge, Pacific wren, Ripley wild buckwheat, Sierra Ancha talussnail, Tonto Basin agave, Toumey groundsel	WFP-DC-06	WFP-G-03
limited available habitat on the forest	American dipper, Arizona bugbane, Blumer's dock, Ripley wild buckwheat, Rusby's milkwort, southwestern willow flycatcher, Yuma Ridgeway's rail	WFP-DC-04; WFP-DC-05; WFP-DC-08	WFP-G-04; WFP-G-05; WFP-G-07
low genetic diversity	Blumer's dock	RNBAMA-DC-02; ERU-DC-11; WFP-DC-03; WFP-DC-04; WFP-DC-05; WFP-DC-08	FP-G-07; WFP-G-03; WFP-G-04; WFP-G-05; WFP-G-07; WFP-G-08
poor reproduction	Arizona cliffrose, Bezy's night lizard, Grand Canyon century plant, Tonto Basin agave	WFP-DC-03; WFP-DC-04	WFP-G-04; WFP-G-05
potential reproductive isolation	Arizona giant sedge (syn. Cochise sedge), Gila topminnow, Milk Ranch Talussnail, narrow-headed gartersnake, ocelot, Rusby's milkwort, Tonto Basin agave, Toumey groundsel, Yuma Ridgeway's rail	WFP-DC-05	WFP-G-04; WFP-G-08
restricted distribution	A mayfly, Ancha mountainsnail, Aravaipa sage, Arizona bugbane, Arizona giant sedge (syn. Cochise sedge), Bezy's night lizard, Blumer's dock, broadleaf lupine, Chiricahua leopard frog, Colorado pikeminnow, Davidson sage, desert pupfish, Fish Creek fleabane, Fish Creek rock daisy, Flagstaff Beardtongue, fossil springsnail, Gila rock daisy, Gila topminnow, Gila trout, Grand Canyon century plant, Hodgson's fleabane, horseshoe deer vetch, James' rubberweed, loach minnow, mapleleaf false snapdragon, marsh rosemary, Metcalfe's tick-trefoil, Milk Ranch Talussnail, Mt. Dellenbaugh sandwort, narrow-headed gartersnake, Pringle's fleabane, razorback sucker, Ripley wild buckwheat, roundtail chub, Rusby's milkwort, Salt River rock daisy, Senator Mine alumroot, Sierra Ancha fleabane, Sierra Ancha talussnail, Sonoran	No specific plan components address this issue	No specific plan components address this issue

Threats to persistence	Species Affected	Desired Conditions	Objectives, Standards, and Guidelines
	maiden fern, southwestern willow flycatcher, spikedace, Tonto Basin agave, Toumey groundsel, Verde Rim springsnail, yellow-eyed junco, Yuma Ridgeway's rail		
small population size	A mayfly, American dipper, Colorado pikeminnow, desert pupfish, Fish Creek fleabane, Gila chub, Gila topminnow, Gila trout, Grand Canyon century plant, Hodgson's fleabane, Hohokam agave, Metcalfe's tick-trefoil, Milk Ranch Talussnail, Mt. Dellenbaugh sandwort, ocelot, Pacific wren, razorback sucker, Rusby's milkwort, Salt River rock daisy, Sonoran maiden fern, spikedace, yellow-eyed junco	WFP-DC-03; WFP-DC-04	WFP-G-04; WFP-G-05
trampling	Arizona hedgehog cactus, Blumer's dock, Verde Rim springsnail	RNBAMA-DC-06; GRZ-DC-03	RNBAMA-G-06; RWMA-G-04
unlawful collection	Arizona hedgehog cactus, broadleaf lupine, Sonoran maiden fern	WFP-DC-06	FP-G-07; FP-G-09

Cumulative Effects

Four Forest Restoration Initiative

The Four Forest Restoration Initiative (4FRI) includes 2.4 million acres of northern Arizona ponderosa pine forests and associated ecosystems, approximately 300,000 acres of which are on the Tonto National Forest. The intent of the initiative is to restore the area to healthy resilient forests that support natural fire regimes and reduce the risk of uncharacteristically severe wildfire and provide quality habitat that supports healthy populations of native plants and animals. This effort is very likely to improve many departed habitats for wildlife, primarily in frequent fire systems. This long-term and large-scale project is likely to restore many structural components considered beneficial to species and work to reduce the risk of uncharacteristically severe fire.

Travel Management

The Travel Management Plan proposes to decommission 1,292 miles of motorized routes on the forest. Eventual decommissioning of these routes would reduce the miles of roads within a three-hundred-foot buffer distance of perennial, intermittent and ephemeral streams, and lakes. It would reduce the miles of roads within riparian areas and the number of crossings of perennial, intermittent and ephemeral streams. It would also reduce motorized route density on the forest to. Reduction in the number of miles of motorized routes is likely to reduce impacts to species sensitive to direct or indirect impacts of roads and motorized travel.

Mining Activities

Mineral prospecting and mining is an activity within and near the forest that has occurred for many years. Mineral prospecting by itself has only small surface disturbing activities but mining economical ore deposits can affect larger areas with tailings ponds, leach pads, power, water and other mining infrastructure. Impacts to surface water quantity and quality and groundwater quality and quantity as well as water dependent resources dependent on them have occurred in the past and may occur in the future. The Resolution Copper Project near Superior is currently being evaluated in an environmental impact statement and an environmental impact statement is also being prepared for expansion of the Pinto Valley Mine near Miami-Globe. These projects have the potential to create surface disturbance and affect water resources. Other mineral exploration activities are occurring on the forest. If economically viable ore deposits are discovered and developed, they also have the potential to affect watershed conditions and water resources on the forest.

Tribal Management Activities

The forest is bordered on the east by the Fort Apache and San Carlos Indian Reservations. Watersheds drain primarily from the forest to the reservations. The San Carlos reservation is developing a plan for reducing fuel loadings on both the reservation and the forest in a collaborative process with the forest. Implementation should reduce fuel loading in the thumb area of the Tonto as well as on portions of the San Carlos Reservation bordering the Tonto. Fuel management efforts also occur on the Fort Apache Reservation. These efforts should benefit and complement fuel reduction efforts on the forest and benefit watershed conditions and help reduce the risk of uncharacteristically severe fire.

Population Growth

The Phoenix metropolitan area is projected to grow rapidly in the near future. As such, it is likely that the number of visitors to the forest will also increase. The increasing footprint from recreationist and other forest users is likely to have an impact on at-risk species on the forest. Disturbances can take the form of habitat degradation, direct mortality, or behavior disturbance. Simultaneously, resources for managing current and future influxes of visitors are limited, increasingly the likelihood of strain on many species.

Population growth may also impact watershed and water resources as the demand increases over time. This is already a vitally strained resource for many species in a largely arid environment. In the face of a warming climate, the strain on this natural resource is likely to become more intense over time.

Climate Change

In general, most climate modelers agree that the Southwest is trending toward prolonged drought. Future potential ecological effects in the Southwest may include an increase in more intense disturbance events such as wildfires, monsoons, and wind. Changing ecological conditions could provide greater opportunities for invasion by nonnative species and disease with the potential to negatively impact various taxa. General trends toward increased moisture deficit could limit overall forest productivity and associated changes in vegetation patterns could affect overall distribution and range of plant and animal species. Cumulatively these factors would likely impact biodiversity, however to what extent is currently uncertain (Heller 2009, Periman 2008, Periman et al. 2009 and references therein).

Regional Forester Sensitive Species

The regional forester's sensitive species program is the Forest Service's dedicated initiative to conserve and recover plant and animal species according to Forest Service policy (FSM 2670). The Tonto National Forest improves habitat and restores ecosystems for sensitive species through vegetation treatments and management practices. Sensitive species are those plant and animal species identified by a regional forester for which population viability is a concern, as evidenced by the following:

- Significant current or predicted downward trends in population numbers or density
- Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Forty-two regional forester sensitive species are found on the Tonto National Forest, identified in table 179. This analysis will focus on potential long-term and short-term effects to habitat, amount of occupied habitat, or changes in habitat quantity and quality.

It is important to note that species of conservation concern will replace regional forester sensitive species as part of plan revision. Both categories were established so species remain viable on National Forest System lands, and therefore it is unnecessary to apply the processes for sensitive species to administrative units once forest plan revision under the 2012 planning rule is completed. Applying both systems on the same administrative unit would be redundant.

The following ecological response unit (ERU) acronyms are used in table 179:

- DES Desert Ecosystems
    - SDS = Sonora-Mojave mixed-salt desert scrub;
    - MSDS = Sonoran Mid-Elevation Desert Scrub
- IC Interior Chaparral
- MCD Mixed Conifer–Frequent Fire
- MCW Wet Mixed Conifer/Mixed Conifer with Aspen
- MEW Madrean Encinal Woodland
- MPO Madrean Pinyon Oak
- PJC Pinyon-Juniper Evergreen Shrub
- PJG Pinyon-Juniper Grass
- JUG Juniper Grass
- PJO Pinyon-Juniper Woodland
- PPE Ponderosa Pine-Evergreen Oak
- PPF Ponderosa Pine Forest
- PG Perennial Grass Subclass
- SDG Semi-Desert Grasslands

Table 179. Regional forester's sensitive species on the Tonto National Forest, ecological response unit (ERU) code(s), potential habitat on the forest, and designation as a species of conservation concern

Common Name	Scientific name	ERU Code	Potential Habitat on the Forest	Identified as Species of Conservation Concern
A caddisfly	*Wormaldia planae*	RMZ, WAT, RMZ, WAT	16.8 miles of perennial stream	Yes
A mayfly	*Fallceon eatoni*	RMZ, WAT	125.1 miles of perennial stream	Yes
Allen's big-eared bat	*Idionycteris phyllotis*	MSDS, PJC, PJO, PPF, PPE, RMZ, WAT	15.45 acres	No
American peregrine falcon	*Falco peregrinus*	All	Forestwide*	No
Aravaipa sage	*Salvia amissa*	IC, MEW, PJC, RMZ, WAT	57,063 acres	Yes
Aravaipa woodfern	*Thelypteris puberula*	RMZ, WAT	84,776 acres	Yes, listed under the variety local to the southwest under common name Sonoran maiden fern
Arizona bugbane	*Cimicifuga arizonica* (syn. *Actaea arizonica*)	MCD, PPE, RMZ, WAT	131,741 acres	Yes
Arizona giant sedge (syn. Cochise sedge)	*Carex ultra* (syn. *C.spissa var. ultra*)	RMZ, WAT	145,007 acres	Yes
Bezy's night lizard	*Xantusia bezyi*	SDS, MSDS-CB, MSDS, IC	66.26 acres	Yes
Blumer's dock	*Rumex orthoneurus*	MEW, MCD, PPF, PPE, RMZ, WAT	131,714 acres	Yes
Chihuahuan sedge	*Carex chihuahuensis*	RMZ	145,007 acres	Yes
Chiricahua Mountain alumroot	*Heuchera glomerulata*	RMZ, WAT	49.56 acres	No
Desert sucker	*Catostomus clarkii*	RMZ, WAT	16,493.43 acres	No
Fish Creek fleabane	*Erigeron piscaticus*	IC, RMZ, WAT	124,568 acres	Yes
Fish Creek rock daisy	*Perityle saxicola*	MSDS, MSDS-CB, PJC	1,210,287 acres	Yes
Fossil springsnail	*Pyrgulopsis simplex*	RMZ, WAT	17.13 acres	Yes
Headwater chub	*Gila nigra*	RMZ, WAT	447.9 miles of perennial stream	Yes, considered part of roundtail chub species complex
Hohokam agave	*Agave murpheyi*	MSDS-CB, MSDS, IC, RMZ	84 acres	Yes

Common Name	Scientific name	ERU Code	Potential Habitat on the Forest	Identified as Species of Conservation Concern
Horseshoe deer vetch	*Lotus mearnsii* var. *equisolensis*	SDS, MSDS-CB, MSDS	33.73 acres	Yes
Lowland leopard frog	*Lithobates yavapaiensis*	RMZ, WAT	4,499.37 acres	Yes
Mapleleaf false snapdragon	*Mabrya acerifolia*	MSDS-CB, MSDS, RMZ	808,297 acres	Yes
Mt. Dellenbaugh sandwort	*Eremogone aberrans* (syn. *Arenarwia aberrans*)	PJO, PPF, PPE	10 acres	Yes
Net-winged midge	*Agathon arizonicus*	RMZ, WAT	7.72 acres	Yes
Northern goshawk	*Accipiter gentilis*	MCD, PJC, JUG, PPF, PPE, RMZ	1,431,471 acres	No
Pale Townsend’s big-eared bat	*Corynorhinus townsendii pallescens*	SDS, IC, PJC, PJG, PJO, PPF, PPE, SDG	114.06 acres	No
Parker’s cylloepus riffle beetle	*Cylloepus parkeri*	RMZ, WAT	53.53 acres	No
Pima Indian mallow	*Abutilon parishii*	MSDS, WAT	34.70 acres	No
Ripley wild buckwheat	*Eriogonum ripleyi*	MSDS, SDS, MSDS-CB	94.18 acres	Yes
Roundtail chub	*Gila robusta*	RMZ, WAT	447.9 miles of perennial stream	Yes
Rusby's milkwort	*Polygala rusbyi* (syn. *Rhinotropis rusbyi*)	SDS, MSDS-CB, MSDS	29.74 acres	Yes
Salt River rock daisy	*Perityle gilensis var. salensis*	MSDS-CB, MSDS, IC, PJG, RMZ, SDG	1,526,501 acres	Yes
Senator Mine alumroot	*Heuchera eastwoodiae*	MCD, PPF, PPE, RMZ	49.56 acres	Yes
Sierra Ancha fleabane	*Erigeron anchana*	IC, PJC, PPE, RMZ, WAT	1,209,470 acres	Yes
Sonoran desert tortoise	*Gopherus morafkai*	MSDS-SP, MSDS, MSDS-CB, SDS	1,016,735 acres	No
Sonoran sucker	*Catostomus insignis*	RMZ, WAT	4,248.80 acres	No
Spotted bat	*Euderma maculatum*	All	Forestwide*	No
Sulphur-bellied flycatcher	*Myiodynastes luteiventris*	RMZ	17,731.10 acres	No
Tonto Basin agave	*Agave delamateri*	MSDS, MSDS-CB, IC, PJG	247.81 acres	Yes

Common Name	Scientific name	ERU Code	Potential Habitat on the Forest	Identified as Species of Conservation Concern
Toumey groundsel	*Packera neomexicana* var. *toumeyi*	IC, MEW, PJC, PPE	54.52 acres	Yes
Verde breadroot	*Pediomelum verdiensis*	MSDS, MSDS-CB	808,297 acres	Yes
Western red bat	*Lasiurus blossevilli*	RMZ, WAT	84,776 acres	No
Yellow-eyed junco	*Junco phaeonotus*	MEW, MCD	153, 643 acres	Yes

*Forestwide indicates species potential habitat is on 2,864,080 acres, which reflects only National Forest System lands within the administrative boundary of the Tonto National Forest. All lands of other ownership have been removed; therefore, it is fewer acres than land covered by the Tonto National Forest.

Plants Affected Environment

Aravaipa sage (Salvia amissa)

Aravaipa sage is a perennial, riparian obligate species. The leaf shape, leaf hairs, and elevation distinguish *S. amissa* from the other 14 Salvia species in Arizona. Aravaipa sage is known from five sites on the Tonto National Forest in the Lower Salt and Upper Salt (Sierra Ancha Mountains) zones. Some suspect the species to be extirpated at the Superstition Mountains in the Lower Salt zone (Gori, 1999 in Arizona Game and Fish Department 2002). Plants are restricted to wetlands and riparian areas and are found at upper alluvial terraces in shady canyon bottoms, along streambanks, and in cienega-like graminoid and herb communities (Arizona Game and Fish Department 2002, SEINet 2016). Plants are also under the canopies of mature sycamore (*Platanus wrightii*), walnut (*Juglands major*), ash (*Fraxinus velutina*) and mesquite (*Prosopis* sp.). Population sizes are cited as locally abundant where found (Arizona Game and Fish Department 2002). However, plants are rarely found in suitable or potential habitat (Warren 1994).

On the Tonto National Forest, sites are associated with the cottonwood riparian ecological response unit. Adjacent plant communities include ponderosa pine-evergreen oak and mixed conifer-frequent fire (Sierra Ancha Mountains) ecological response units. Fifty percent of the streams assessed in the cottonwood riparian ecological response unit are rated as impaired, with another 33 percent rated as unstable. Plant surface roots anchor and stabilize soils. Current conditions show a substantial loss in surface roots indicating a potential loss in streambank stability at sites (reference “Riparian” section). While fires generally do not occur in the riparian corridor, areas with high fuel loads and located adjacent to rivers can increase fire spread and severity in the riparian zone (specifically when sites are experiencing drought).

Current conditions show high fuel loads in the adjacent plant communities and surrounding watershed, increasing the risk of wildfire and subsequent soil loss (from heating), runoff, sedimentation, and increased flooding. The few sites on the Tonto (four reliably documented) and degraded habitat conditions raise substantial concern for the species’ persistence on the Tonto National Forest.

Aravaipa woodfern (Thelypteris puberula)

Aravaipa woodfern is lacking information on population trends and threats (Arizona Game and Fish Department 2004, NatureServe 2016). Surveys and research are needed to determine suitable habitat and habitat requirements on the Tonto (6). This rare fern occurs in several scattered localities across central Arizona including BLM sites in the Arrastra Mts. and Aravaipa Canyon in the Galiuro Mts. and National Forest System sites in the Catalina Mts. and the Four Peaks area (located on the Tonto National Forest). There are additional populations in Mexico and California. Spring development and water diversion could damage its localized wetland habitat. Prolonged drought could dry up some sites.

Arizona bugbane (Cimicifuga arizonica (syn. Actaea arizonica)

Arizona bugbane is a perennial herb with populations known from the Mogollon Rim with disjunct sites at the Bill Williams Mountain in Coconino County and the Sierra Ancha Mountains (Tonto National Forest) in Gila County. Arizona bugbane is associated with the ponderosa pine/willow and cottonwood riparian ecological response units on the Tonto. Adjacent upland communities include ponderosa pine-evergreen oak and mixed conifer-frequent fire ecological response units. Plants are associated with particular habitat conditions: slopes greater than 30 degrees with little to no direct sun, and north aspects with deep to rich saturated soils where waterfalls and weeping cliffs drip onto individuals. These conditions are considered rare compared to the other known Arizona bugbane sites in the state and uncommon on the Tonto National Forest (Rink 2016).

The most noted direct threats on the Tonto come from recreation with numerous minor accounts documented (Gobar 1990, Lutch 1998, Philips 1982, Warren 1991). Also, changes in humidity, water quality, streamflow, and canopy cover could severely affect populations (US Fish and Wildlife Service 1992, Philips 1984). Over 50 percent of the streams in both the cottonwood and ponderosa pine/willow ecological response units are rated as impaired. Ponderosa pine-evergreen oak and mixed conifer-frequent fire ecological response units are highly departed across the Tonto National Forest with the highest departure at the Upper Salt and Tonto Basin zones. All known populations and potential habitat are located in these local zones.

Current conditions show high fuel loads in both ponderosa pine-evergreen oak and mixed conifer-frequent fire ecological response units. Projections show slight improvement, specifically in the ponderosa pine-evergreen oak ecological response unit, but overall habitat conditions remain moderately departed. High fuel loads increase the risk of wildfire and subsequent soil loss (from heating), runoff, sedimentation, and flood scouring at nearby riparian areas. While recent findings suggest plants may be adapted to more frequent disturbance (reestablishing from buried rhizomes) than previously thought (Rink et al. 2015), population renewal tends to occur more from the seed banks than surviving individuals (Ayre et al. 2009). Also, increased flooding may eliminate upstream propagule sources and reduce the seed bank and genetic diversity of downstream populations over time. It is unclear what other negative impacts) may have on Arizona bugbane populations; for example, increased flooding from wildfire, soil heating, altered microsite conditions, and reduced canopy cover.

Arizona phlox (Phlox amabilis)

Arizona phlox is a perennial low-growing plant found in limestone and granite substrates among north, east, and west-facing slopes. Most populations are found at elevations from 3,500 to 8,970 feet. Growth habits noted for this species include woody subshrub, woody shrub, and herbaceous forb and herb. Arizona phlox is primarily distributed north of the Tonto (most in Coconino and Yavapai Counties). Plants are found in a number of habitat types, do not appear to be restricted by specific habitat features (specific soils or substrates). Surveys are needed to determine current and potential habitat on the Tonto (last documented on the national forest in 1976) Also, information on Arizona phlox response to fire, impacts of grazing and off-highway vehicle use are needed to assess species viability.

Blumer's dock (Rumex orthoneurus)

Blumer’s dock is a long-lived, herbaceous perennial; Forest Service sensitive species; and designated as “highly safeguarded protected” under the Arizona Native Plant law (1993). On the Tonto National Forest in the Sierra Ancha Mountains, four natural populations have been documented but only three extant populations confirmed (Thompson and Hodges 1996). In addition to the native populations, 17 transplanted populations were established along the Rim at the Tonto Basin and Upper Salt zone. Eight populations have been extirpated, one is potentially stable, and nine have experienced declines in the number of individuals (Thompson and Hodges 1996). Reasons for population declines on the Tonto include severe flooding following wildfires (Dude and Bray fires in 1990), grazing impacts, and insect herbivory (Arizona Game and Fish Department 2002, Thompson and Hodges 1996). Other negative impacts to populations on the Tonto include trampling (livestock, horses) and habitat degradation from road construction, water developments, and recreation-related activities such as camping and hiking (Thompson and Hodges 1996).

Blumer’s dock occurs in riparian habitats at elevations between 4,480 and 9,660 feet (Arizona Game and Fish Department 2002). On the Tonto National Forest, the adjacent plant communities and ecological response units are mixed conifer-frequent fire and ponderosa pine-evergreen oak and the riparian ecological response units are cottonwood and ponderosa pine/willow. Key habitat features include moist loamy soils adjacent to springs, flowing streams in open meadows, and meadows with canopy cover. Plants can be found at the drier headwaters of some areas. They typically occur in open, sunny locations but can occupy more shaded sites. Suitable habitat makes up a small proportion of the Tonto (combined acreage for ponderosa pine-evergreen oak and mixed conifer-frequent fire ecological response units is 9 percent).

Current conditions show high seral state departure for ponderosa pine-evergreen oak and mixed conifer-frequent fire ecological response units through the Tonto National Forest. Ponderosa pine-evergreen oak departure is the highest at the Upper Salt zone, where all natural populations are located (Sierra Ancha Mountains). Additionally, departure is moderate to high at introduced sites: Lower Verde and Tonto Basin zones. Both ponderosa pine-evergreen oak and mixed conifer-frequent fire ecological response units have high fuel loads (coarse woody debris and high shrub densities) with a significant acreage in fire regime condition class III (greater than 40 percent for both ecological response units) indicating high departure in fire regime. High fuel loads increase the risk of severe wildfire and subsequent soil loss (from heating), runoff, sedimentation, and flood scouring at nearby riparian areas. These factors can greatly reduce or eliminate Blumer's dock populations. Fifty-one percent of the riparian streams on the Tonto National Forest are rated as impaired, with the highest ratings at the Upper Salt (62 percent impaired). Ponderosa pine-evergreen oak and mixed conifer-frequent fire ecological response units will remain moderately departed. Projections show a large number of acres in closed-canopy states, increasing the risk of wildfire, insects, and disease.

Blumer's dock was proposed for Federal listing but withdrawn in 1999 because threats were deemed not sufficiently widespread across the species entire range. Populations on the Coronado and Tonto National Forests (implemented in 1993) are being monitored under a conservation strategy. When the species was proposed for listing it was only known from 10 sites in Arizona. Genetic work confirmed populations previously identified as *R. occidentalis* were in fact *R. orthoneurus*, confirming an additional 134 sites (excluding the introduced sites). Asexual reproduction through rhizomes results in low genetic diversity at sites, so preserving populations at distinct mountain ranges across the species' range is important to maximize the genetic variation and overall gene pool (Federal Register 64:125, August 9, 1999). The loss of populations on the Tonto National Forest (Sierra Ancha Mountains) could lower the viability of the species overall. A number of other factors, such as declining population numbers (specifically at introduction sites), few sites on the Tonto, degraded riparian habitat conditions and wildfire risk, pose significant threats to Blumer's dock.

Chihuahuan sedge (Carex chihuahuensis)

This plant grows in wet meadows, cienegas, marshy areas, and canyon bottoms. Grazing can heavily impact these areas if not properly managed. Current taxonomy is unclear in this species due to overlapping in some of the character states distinguishing *C. chihuahuensis* and *C. alma*, warranting further research on the species. The state status was changed from S2 to S3 based on recent information (Arizona Rare Plant Advisory Group).

Chiricahua mountain alumroot (Heuchera glomerulata)

This species is found in shaded rocky slopes in humus soil near seeps, streams, and riparian areas of mountain ranges in southeastern Arizona. It appears to be limited and it is infrequently collected. Its wetland habitats are vulnerable to impacts from livestock, recreation, wildlife, etc.

Cochise sedge (Carex ultra syn. C.spissa var. ultra)

This plant grows in saturated soil near perennial seeps, streams, and springs. Grazing can heavily impact these areas if not properly managed. The amount of occupied habitat is generally unknown.

Fish Creek fleabane (Erigeron piscaticus)

This species is an extremely rare annual only known from three localities: two in Arizona and one in Sonora, Mexico. Population sizes are very small, averaging less than 80 individuals (Arizona Game and Fish Department 2001, SEINet 2016). The current status of populations on the Tonto National Forest is unknown but the fleabane has been documented from the historical Fish Creek site in 1921 and 1931 at the Superstition Mountains (Arizona Game and Fish Department 2001). According to Dave Gori (1999), there are no extant populations in the state of Arizona except at Oak Grove Canyon (outside the Tonto National Forest). However, plants are rare annuals. They may not emerge in some years; therefore, populations are assumed to be extant and not extirpated on the Tonto. Additionally, plants may require specific environmental conditions over periods of time to germinate and establish (Arizona Game and Fish Department 2001). Plants are found in riparian areas in woodlands and moist alluvium at shady canyon bottoms along perennial streams. Suitable habitat in the Superstition Mountains include the Cottonwood riparian ecological response unit and adjacent communities include Sonoran Desert Scrub, Interior Chaparral, and Semi-Desert Grassland ecological response units. Threats include poor watershed conditions, recreation (hiking traffic), and flooding (Arizona Game and Fish Department 2001, Interagency Sensitive Plant Assessment 2004). Fifty percent of the streams assessed in the Cottonwood riparian ecological response unit are rated as impaired, with another 33 percent rated as unstable.

Plant surface roots anchor and stabilize soils. Current conditions show a substantial loss in surface roots indicating a potential loss in streambank stability (reference “Riparian” section). No surveys have been conducted to determine the extent of populations within suitable habitat on the Tonto National Forest. Therefore, the uncertainty (site on the Tonto not surveyed in over 25 years), the extreme rarity on and off the Tonto, and the degraded site conditions raise substantial concern for Fish Creek fleabane persistence.

Fish Creek rock daisy (Perityle saxicola)

Fish Creek rock daisy is an herbaceous perennial with an extremely limited distribution. The entire species range is on the Tonto National Forest at the Upper Salt zone, and all known sites are within 5 miles of each other (Arizona Game and Fish Department 2004, SEINet 2016). Plants are found on very steep slopes and in the cracks and crevices of cliff faces, large boulders, and rocky outcrops that occur in canyons with east and northeast exposures. Suitable habitat on the Tonto includes Sonoran Desert Scrub and Pinyon-Juniper Evergreen Shrub (Sierra Ancha Mountains) ecological response units. While suitable habitat makes up a significant proportion of the Tonto National Forest (combined ecological response unit acreage is 40 percent of the Tonto), plants are only known to occupy a very small proportion of the habitat.

Fire is most likely a low threat because the adjacent communities are predominately in the Sonoran desert scrub ecological response unit, and they lack the fuels capable of affecting plants at cliff faces. However, there are a few sites and moderate amount of potential habitat in the pinyon-juniper evergreen shrub ecological response unit. Wildfires in the Pinyon-juniper evergreen shrub ecological response unit are more likely to produce hot fires capable of damaging individuals. Current condition shows high seral state departure in this ecological response unit. Fire suppression and grazing in this type have contributed to a lengthening of the fire return interval to 215 years instead of the 35 to 100 or more years found under reference conditions. This has allowed the coarse woody debris to build up to 23.9 tons per acre, changing the fire behavior to the point where wildfires are more resistant to control.

While some populations are less impacted by direct impacts from wildfire (plants at cliff faces), indirect effects from wildfires, such as intense heating, may damage individuals and alter local site conditions. While conditions are projected to improve, the pinyon-juniper evergreen shrub ecological response unit will still be moderately departed with 31 percent of acres in a closed-canopy state. Closed-canopy conditions increase stress and insect and pathogen outbreaks and change wildfire behavior. Additionally, while there is moderate uncertainty on the vulnerability of the pinyon-juniper evergreen shrub ecological response unit to climate change, juniper communities (juniper grass, pinyon-juniper grass, pinyon-juniper woodland) overall are highly vulnerable to climate change (see the Climate Change section in volume 1). The limited range, along with the impaired habitat conditions over a moderate percent of the potential habitat (Sierra Ancha Mountains), make the Fish Creek rock daisy particularly vulnerable to extirpation on the Tonto National Forest.

Hohokam agave (Agave murpheyi)

Hohokam agave is a perennial succulent usually found on benches or alluvial terraces on gentle bajada slopes (not steep slopes or drainage bottoms) above major drainages in the Mojave Sonoran desert scrub ecological response unit. The species is associated with pre-Columbian agricultural and settlement features (cultivated by the Hohokam). Murphey's agave is found in all local zones on the Tonto but not at high densities (SEINet 2016). Population sizes are relatively small, with each distinct population having fewer than 50 individuals (NatureServe 2016). Recent population declines have been observed at a number of sites (W. Hodgson and A. Salywon, personal communication, 2016). As with most agaves, Hohokam agave is probably self-incompatible requiring outcrossing, with the primary mode of reproduction being vegetative through rhizomatous offsets called pups (Arizona Game and Fish Department 1997). Few, if any, seeds develop; they are aborted soon after flowers develop (Arizona Game and Fish Department 1997).

While habitat loss from urban sprawl and development poses the highest threat to Hohokam agave, fires may increase habitat loss where vegetation is dense. While current conditions show an overall low departure (seral state) for the Mojave Sonoran desert scrub ecological response unit, fifty-five percent of the acres are in fire regime condition class III, indicating high departure in fire regime. Increased shrub densities and exotic grasses at sites have contributed to the altered fire regime (increasing the risk of fire frequency and severity) in the Mojave Sonoran desert scrub ecological response unit. This ecological response unit is projected to trend away from reference conditions resulting in decreased cacti, shrub, and tree cover and an increase in exotic grass cover (increasing the risk of uncharacteristic fire).

The reconstruction of the Roosevelt Dam and expansion of Roosevelt Lake resulted in the elimination of a Hohokam agave clone (Arizona Game and Fish Department 1997). While there are currently no plans to expand any reservoirs on the Tonto National Forest, future developments can potentially eliminate populations.

Agave roots are shallow and spread outward to capitalize on moisture in the upper soil layers. While direct damage to individuals from recreation (such as off-highway vehicle use) is low, soil compaction at sites may reduce plant-available moisture. As with most agaves, Hohokam agave is susceptible to root rot and requires well-drained soils (Arizona Game and Fish Department 1997). A loss of soil productivity and function is already evident; current conditions show nearly 50 percent of Mojave Sonoran desert scrub soils are rated as impaired.

Habitat alterations, such as the removal of rock piles can also negatively impact species as rocks discourage rodents and help accumulate nutrients and water. In addition to the departed habitat conditions on the Tonto, another potential threat is illegal collection for cultivation and products. These factors, along with the small population sizes and limited reproductive potential, increase the likelihood of local extinction or extirpation of Hohokam agave on the Tonto National Forest.

Hohokam agave (*Agave murpheyi*) is found in south-central Arizona in the Sonoran Desert. It is found on gentle bajada slopes, benches, or terraces above major drainages with prehistoric habitations and/or agricultural sites, typically between 1,300-2,400 feet elevation. It requires well-drained soil. There are about 60 known sites in Arizona. On the forest, Hohokam agave habitat consists of approximately 84 acres.

Horseshoe deer vetch (Lotus mearnsii var. equisolensis)

This species is extremely restricted. The only known population for the state of Arizona is located on the Tonto National Forest, covering 2.2 square kilometers; it is of very high conservation concern (Arizona Rare Plant Assessment 2014). All known occurrences are located in the Cave Creek Ranger District. Horseshoe deer vetch habitat consists of 33.73 acres on the forest. Plants are found growing on calcareous soils in the Sonora-Mohave mixed salt desert scrub ecological response unit and potential habitat includes the Sonoran Desert Scrub ecological response unit.

While current conditions show low seral state departure for the Sonora-Mohave mixed salt desert scrub ecological response unit, habitat degradation is apparent. More than 80 percent of soils in Sonora-Mohave mixed salt desert scrub are rated as impaired to unsatisfactory. Nearly 50 percent of soils in the Sonoran desert scrub ecological response unit are impaired. Impaired and unsatisfactory soils can result in unstable soils with reduced hydrological function and nutrient cycling.

Direct threats to the species are unknown; however, the habitat is highly susceptible to negative impacts from the expansion of reservoirs and off-road vehicle use. Limited distribution, uncertainty about the extent of suitable habitat (no surveys conducted), and degraded habitat conditions raise substantial concern for horseshoe deer vetch persistence on the Tonto National Forest.

Mapleleaf false snapdragon (Mabrya acerifolia)

Mapleleaf false snapdragon is a perennial vine. It is the only species in the Genus *Mabrya* and may be a paleoendemic (Arizona Rare Plant Assessment 2014). The species range is very small, with a majority of the habitat on the Tonto National Forest (SEINet 2015). This prostrate, mat-forming plant is found at rock overhangs, on shaded cliffs, rock ledges, and Rhyolite rock crevices at north- to east-facing canyon walls. Mapleleaf false snapdragon is narrowly distributed on the Tonto National Forest, with all sites located in the Lower Salt zone. The Sonoran desert scrub ecological response unit makes up a moderate amount of suitable habitat on the Tonto (22 percent), but plants occupy a relatively small proportion of the suitable habitat because they are restricted to specific habitat features – rock crevices and cliff faces.

Future projects in the Salt River Canyon and Superstitions (such as trail construction and dam construction) may negatively impact the species (Lutch 2000). Also, the extremely limited range and negative impacts from potential mining raise concern for the species' persistence (Interagency Sensitive Plant Assessment 2004). Current conditions show low seral state departure in the Sonoran desert scrub ecological response unit, with projections showing high seral departure (100-year projection). Plants are probably less influenced by the conditions of the associated habitat and more impacted by other factors such as habitat loss from mining, recreational activities (trail construction) and dam building.

Many cliff-dwelling ecosystems harbor a number of rare and uniquely adapted species that contribute greatly to regional biodiversity (Larson et al. 2000). Recreational activity (rock climbing) within these ecosystems can reduce plant size, vigor, and genetic diversity (Volger and Reish 2011). While there is currently no information on whether cliff climbing is impacting species on the Tonto National Forest, a number of sites are close (Superstition Mountains) to the Phoenix metropolitan area. The Tonto experiences high recreational impacts, and recreation is expected to increase with increasing population growth and urban expansion. For these reasons, there is substantial concern for the viability of Mapleleaf false snapdragon on the Tonto National Forest.

Mt. Dellenbaugh sandwort (Eremogone aberrans syn. Arenarwia aberrans)

Mt. Dellenbaugh sandwort is a perennial herb and Arizona endemic found throughout north and north-central Arizona. On the Tonto National Forest, there are only two known occurrences at the Tonto Basin and Upper Salt local zones (SEINet 2016). Mt. Dellenbaugh sandwort habitat consists of approximately 10 acres across the forest. Plants are mostly associated with pinyon-juniper woodland and occasionally ponderosa pine forest and ponderosa pine-evergreen oak ecological response units. While seral state departure is low (current and projected) for the pinyon-juniper woodland ecological response unit, climate change vulnerability is high for this ecological response unit.

The effects of fire on the viability of Mt. Dellenbaugh sandwort are unclear; however, current conditions show high risk of catastrophic fires beyond what would be expected under the natural range of variation in ponderosa pine forest and ponderosa pine-evergreen oak ecological response units. Dense, closed-canopy stands; large patch sizes; and high accumulations of coarse woody debris are the primary factors responsible for the increased wildfire risk in these habitat types. No surveys have been conducted to determine the extent of populations in suitable habitat on the Tonto; therefore, the uncertainty (only 2 documented sites) and the degraded site conditions raise substantial concern for the species' persistence.

Pima Indian mallow (Abutilon parishii)

Pima Indian mallow occurs in full sun within higher elevation Sonoran desert scrub, desert grassland, and Sonoran deciduous riparian forest. Typical localities are on rocky hillsides, cliff bases, lower side slopes, and ledges of canyons among rocks and boulders. Habitable slopes can exceed 45 degrees. In riparian zones, it can occur on flat secondary terraces but typically not in canyon bottoms. Pima Indian mallow habitat consists of 34.70 acres across the forest.

Surveys have documented an increase in the current and potential habitat for this species from Sonoran Mexico to Bagdad, Arizona. Although still considered rare, the species is more widespread than originally thought (Arizona Game and Fish Department 2000). No real threats have been identified for populations in Arizona (Arizona Game and Fish Department 2000). Plants generally occur in steep habitat where any potential threats (trampling, livestock grazing, recreation) are greatly minimized (Arizona Game and Fish Department 2000, Lutch 2000).

Ripley wild buckwheat (Eriogonum ripleyi)

Ripley wild buckwheat is a low, herbaceous perennial subshrub found at one locality at the Lower Verde zone on the Tonto National Forest. Plants grow on white powdery gypseous limestone of Tertiary lakebed deposits. The single locality on the Tonto represents one of five widely separated localities in central to northwestern Arizona (Arizona Game and Fish Department 1997). All known occurrences on the Tonto National Forest occupy a relatively small geographic extent, consisting of some 94.18 acres across the forest.

Plants are found in calcareous soils in the Sonora-Mohave mixed salt desert scrub ecological response unit. Nearby communities and potential habitat include Mojave Sonoran desert scrub and pinyon-juniper woodland ecological response units. Soils maps identify large areas of potential habitat that have not been surveyed (Phillips 1996 in Lutch 2000). Habitat degradation is apparent, with more than 80 percent of soils in the Sonora-Mohave mixed salt desert scrub ecological response unit rated as impaired to unsatisfactory. Mojave Sonoran desert scrub and pinyon-juniper woodland ecological response units have moderately impaired soils at 50 and 30 percent, respectively. Impaired and unsatisfactory soils can result in unstable soils with reduced hydrological function (plant-available moisture) and nutrient cycling.

Collection for use in gardens is a particular threat to populations on the Tonto. Other threats are the potential expansion of reservoirs and off-road vehicle traffic (with the potential to affect all extant populations). Populations are being extirpated from development and grazing on private land at other sites in the state, so conservation concern is high for populations on the Tonto. The loss of disjunct sites would dramatically reduce the species' range and viability as a whole. The limited known distribution, uncertainty in extent of suitable habitat, and degraded habitat conditions on the Tonto raise substantial concern for Ripley wild buckwheat persistence on the Tonto National Forest.

Rusby's milkwort (Polygala rusbyi syn. Rhinotropis rusbyi)

Rusby's milkwort is narrow endemic restricted to central Arizona. It is found only at one location on the Tonto National Forest at the Lower Verde zone on white lacustrine outcrops in the Mojave Sonoran desert scrub ecological response unit. Habitat consists of pinion-juniper woodlands and semi-desert shrub at elevations ranging from 3,280 to 4,921 feet. On the Tonto National forest, all known populations are found in the desert communities potential natural vegetation type on the Cave Creek Ranger District. Rusby's milkwort habitat consists of 29.74 acres of habitat on the forest.

Habitat loss through land development (private lands) is a large threat to the species range wide. On the Tonto, populations may be negatively impacted by recreational use (off-highway vehicles). This site on the Tonto also harbors other at-risk and sensitive species. Fifty percent of the acres in the Mojave Sonoran desert scrub ecological response unit are rated as impaired and unsatisfactory. Impaired soils can result in unstable soils with reduced hydrological function (for example, plant-available moisture) and nutrient cycling. The extremely limited habitat, isolated nature of populations, rarity, and degraded habitat conditions pose substantial risk to the persistence of Rusby's milkwort on the Tonto National Forest.

Salt River rock daisy (Perityle gilensis var. salensis)

Salt River rock daisy is an herbaceous perennial and one of the two varieties in *Perityle gilensis*. This variety is geographically separated from the typical variety (*P*. var. *gilensis*) and has notably longer, narrow leaves and a trailing habit. The range of this variety is extremely small. There are only two known sites for the species, separated by a distance of 30 miles. One site is located on the Tonto National Forest along the Salt River Canyon in the Upper Salt zone and the other on the Ft. Apache Indian Reservation.

Suitable habitat is similar to the Gila rock daisy – nearly inaccessible crevices on cliff faces, ledges, and rock outcrops in Mojave Sonoran desert scrub, semi-desert grassland, juniper grass, and interior chaparral ecological response units on the Tonto. The suitable habitat makes up a significant proportion of the Tonto, but plants are only known to occupy a very small portion of the habitat at one locality because they are restricted to cliff faces and rock outcrops. Substrates are igneous bluffs and parent material consists of sandstone and sedimentary rock.

Mentioned threats to the species include dam building and reservoir expansion. While there are no plans to expand reservoirs on the Tonto National Forest, future developments could potentially eliminate the taxon entirely (inundation) because of its limited range to one drainage system (Arizona Game and Fish Department 2003, Interagency Sensitive Plant Assessment 2004; Wendy Hodgson, personal communication, 2016).

Fire is most likely a low threat given that most sites are associated with desert communities and these communities lack the efficient fuels capable of affecting plants at cliff faces. However, a large proportion of the potential habitat (juniper grass and interior chaparral ecological response units) further upstream the Salt River Canyon is capable of producing hot fires with the potential to negatively impact the Salt River rock daisy. While direct negative impacts from fires are low, severe fires may damage individuals (from intense heating) and alter local site conditions. Current conditions show low to moderate departure for interior chaparral and juniper grass ecological response units. Juniper grass has an excess coarse woody debris, large patch sizes, and a loss of effective vegetative groundcover capable of carrying nonlethal surface fires. As a result, fire return intervals are much longer and fires are burning at mixed to high severities, deviating away from reference conditions of frequent, nonlethal fires. While the juniper grass ecological response unit is projected to reach low seral state departure, 34 percent of the ecological response unit will still remain in a denser state in the future, rendering it susceptible to outbreaks of insects, pathogens, and stand-replacing wildfire. The extremely limited range and impaired habitat conditions over a large percent of the potential habitat make the Salt River rock daisy particularly vulnerable to extirpation on the Tonto.

Senator Mine alumroot (Heuchera eastwoodiae)

Senator Mine alumroot is a perennial herb endemic to central Arizona. On the Tonto, populations are scattered (present in all local zones) but locally common where found (SEINet 2016). Plants are not restricted to specific substrates or habitat features (that is, low habitat specificity); found at moist slopes in pine forests and canyons, rocky clay, crevices of basalt boulders and deep basaltic soils (3). Senator Mine alum root habitat consists of 49.56 acres across the forest, of which 4.96 acres are located on private lands and 24.80 acres in wilderness areas (Four Peaks, Mazatzal, Salome and Superstitions). Senator Mine alumroot is a distinctive perennial herb found only in central Arizona from 5,000 up to about 8,000 feet elevation, occupying moist slopes in ponderosa pine forests and canyons.

The effects of fire on the species are unknown but plants do occur in habitats where fires occur. Plants may be vulnerable to fires specifically among chaparral habitats (Interagency Sensitive Plant Assessment 2004). Current conditions on the Tonto show low departure in interior chaparral ecological response unit. While interior chaparral mostly experienced high-severity, stand-replacing fires at fire return intervals of 35 to more than 100 years, some areas did experience much shorter fire return intervals of 0 to 35 years. Currently, fire return intervals average 128 years in the ecological response unit. Therefore, while overall seral state departure is low, past fire suppression and exclusion has resulted in the build-up of dead fuel matter at some sites, capable of producing hot fires. Negative impacts are expected to be localized because current conditions show much smaller patch sizes (359 acres) from reference conditions (930-2,120 acres) (1). While these delicate herbs may be sensitive to grazing pressure, the habitat is generally inaccessible (rocky slopes, crevices).

Sierra Ancha fleabane (Erigeron anchana)

Sierra Ancha fleabane is a perennial herb narrowly distributed in central Arizona at elevations between 3,500 and 7,000 feet. A majority of all known sites are located on the Tonto National Forest. Sierra Ancha fleabane is the largest of the *Erigeron pringlei* complex. Populations are found at the Lower Verde, Tonto Basin, and Upper Salt local zones. The populations at the Sierra Ancha Mountains on the Tonto are considered the center of the species geographic range (Arizona Game and Fish Department 2003). Plants are found at granite cliff faces, below roads at major drainages, and scattered along cliff faces near the bottom of canyons in ponderosa pine-evergreen oak, pinyon-juniper evergreen shrub, and interior chaparral ecological response units on the Tonto.

While potential direct threats are low (species inhabits rock crevices and rock faces), current conditions show high fuel loads from the accumulation of coarse woody debris and closed-canopy conditions (in ponderosa pine-evergreen oak and pinyon-juniper evergreen shrub ecological response units) capable of producing very hot fires. Additionally, the highest departure for the ponderosa pine-evergreen oak ecological response unit is at the Upper Salt zone where 7 of 9 sites on the Tonto are located.

While the effects of fire are unknown for Sierra Ancha fleabane, intense heating can potentially damage individuals and alter habitat microclimate. The pinyon-juniper evergreen shrub ecological response unit is projected to trend towards reference conditions but will still remain departed after 100 years, with 31 percent of the acres in closed-canopy states, increasing the risk of wildfire. Additionally, pinyon-juniper habitats are at significant risk of increased drying, stress, and prolonged drought from climate change. Seventy-seven percent of the pinyon-juniper evergreen shrub ecological response unit on the Tonto is assessed to have moderate to high vulnerability to climate change. The Tonto National Forest has a significant influence on the viability of the species because nearly the entire range is located on the Tonto. While direct impacts are low, current and projected conditions show the habitat trending away from reference conditions. For these reasons, there is substantial concern for Sierra Ancha fleabane persistence on the Tonto National Forest.

Tonto Basin agave (Agave delamateri)

Tonto Basin agave is a perennial succulent found at the Lower Verde, Tonto Basin, and Upper Salt local zones. The greatest concentration of sites is at the Tonto Basin zone near the Sierra Ancha and Mazatzal Mountains. Tonto Basin agave reproduces by pups or clones from the base of the parent plant. Little is known about flowering, seed, and fruit development but it is suspected that specific climatic conditions may influence or inhibit flower and fruit development (Arizona Game and Fish Department 2003).

On the Tonto, plants are usually found on south and southwest-facing slope edges and atop benches, occasionally on northeast facing gentle slopes in the Mojave Sonoran desert scrub ecological response unit and occasionally interior chaparral and juniper grass ecological response units. Typical substrates include cobbly and gravelly, deep and well-drained soils at elevations from 2,300 to 5,100 feet. Populations are often associated with prehistoric sites. Tonto Basin Agave habitat consists of 247.81 acres across the forest.

Fires may be a potential threat to agaves where vegetation is dense. While current conditions show an overall low departure (seral state) for the Mojave Sonoran desert scrub ecological response unit, 55 percent of the acres are in fire regime condition class III, indicating high departure in fire regime. Increased shrub densities and exotic grasses have contributed to the altered fire regime (increased fire frequency and severity) in the Mojave Sonoran desert scrub ecological response unit. This ecological response unit is projected to trend away from reference conditions resulting in decreased cacti, shrub, and tree cover and an increase in exotic grass cover (increasing the risk of uncharacteristic fire).

While current and projected conditions show low seral state departure for the interior chaparral ecological response unit, 78 percent of acres are classified as fire regime condition class II, indicating a moderate departure in fire regime. While the interior chaparral ecological response unit mostly experienced high-severity, stand-replacing fires at fire return intervals of 35 to 100 or more years, some areas experienced much shorter fire return intervals of 0 to 35 years. Currently, fire return intervals average 128 years in the interior chaparral ecological response unit. As a result of fire suppression and exclusion, some areas may experience very hot fires due to the build-up of dead fuel matter.

While there are currently no plans to expand reservoirs on the Tonto National Forest, future developments (Roosevelt Lake) can potentially eliminate populations (inundation). Under stressed conditions, plants are susceptible to agave snout weevil damage (beetle-transmitted fungus) and can lead to clone mortality.

Agave roots are shallow and spread outward to capitalize on moisture in the upper soil layers. While direct damage to individuals from recreation (such as off-highway vehicle use) is low, soil compaction at sites may reduce plant-available moisture. As with most agaves, Tonto Basin agave is susceptible to root rot and requires well-drained soils (Arizona Game and Fish Department 2003). A loss of soil productivity and function is already evident; current conditions show nearly 50 percent of Mojave Sonoran desert scrub soils are rated as impaired. These factors, along with the limited reproductive potential, increase the likelihood of local extinction or extirpation of Tonto Basin agave on the Tonto National Forest.

Toumey groundsel (Packera neomexicana var. toumeyi)

Toumey's groundsel is a perennial herb distributed from central to southern Arizona from 3,000 up to about 9,000 feet in elevation, occupying loose rocky soils within conifer woodlands. On the Tonto National Forest, over half of known populations are located in the interior chaparral and ponderosa pine forest potential natural vegetation type, with the rest in mixed conifer and oak woodlands. Toumey's groundsel habitat consists of 54.52 acres of across the forest. Populations relatively widespread in Arizona, with most occurrences in southeastern Arizona (SEINet 2015) (3).

Verde breadroot (Pediomelum verdiensis)

This species is a perennial herb with an extremely limited range centered in the vicinity of Camp Verde (SEINet 2015). Welsh and Licher (2010) recently described the species. A few populations are estimated to be stable but general information, such as limiting factors and the magnitude of current and potential threats for the species, is lacking. No searches have been conducted to confirm sites on the Tonto but because populations are very close to the Tonto National Forest boundary (10 miles from Pine, Arizona), the species is considered a potential species of conservation concern until surveys confirm its absence in the plan area.

Typical habitat includes high desert scrub on Verde limestone substrate and sandy ridges. The Mojave Sonoran desert scrub ecological response unit represents suitable habitat on the Tonto National Forest, and Verde breadroot is most likely restricted to the Lower Verde zone on the Tonto. The Mojave Sonoran desert scrub ecological response unit makes up 22 percent of suitable habitat on the Tonto but because of the species' rarity, it is assumed plants occupy a small proportion of the suitable habitat.

While current conditions show an overall low seral state departure for the Mojave Sonoran desert scrub ecological response unit, 55 percent of the acres are in fire regime condition class III, indicating high departure in fire regime. Increased shrub densities and exotic grasses at sites have contributed to the altered fire regime (increasing the risk of fire frequency and severity) in the Mojave Sonoran desert scrub ecological response unit. This ecological response unit is projected to trend away from reference conditions resulting in decreased cacti, shrub, and tree cover and an increase in exotic grass cover (increasing the risk of uncharacteristic fire).

While the species is documented to occur in disturbed areas, the degree to which it can tolerate repeated ground disturbance (such as off-highway vehicle use or hiking) is unknown. Nearly 50 percent of Mojave Sonoran desert scrub soils are rated as impaired, indicating a loss in soil function and productivity. While threats are poorly known for the species, the extremely limited range and departed current and projected habitat conditions pose substantial risk to Verde breadroot.

Invertebrates Affected Environment

A caddisfly (Wormaldia planae)

W. planae are members of the family Philopotamidae and are one of 16 species of the genus distributed from Canada to South America. While this caddisfly was previously only known from Chiapas, Mexico, it was recently described by Munoz-Quesada and Holzenthal (2008) in Gila and Yavapai counties near Fossil Creek Road and Beaver Creek. *W. planae* adults are short lived, using streamside vegetation, stones, and driftwood for resting. Larval microhabitat preferences are not well known, but areas where it has been detected show high calcium carbonate levels that may exert selective pressures on this species and its habitat use (Stevens and Ledbetter 2014).

While specific threats to *W. planae* have not been identified, potential threats to this species include loss or degradation of aquatic habitats due to water development activities, loss of streamside vegetation, and increased sedimentation due to land management activities. Activities that can or may have contributed to habitat degradation include road construction and maintenance, timber management, fire suppression and subsequent stand-replacing fires, and permitted livestock grazing. Management needs include protection of spring source, and periodic monitoring of populations and their habitats (Stevens and Ledbetter 2014).

This species is restricted to the cooler spring-fed streams in mountainous regions. On the Tonto National Forest, this species may be found in the Payson Ranger District; however, no additional data are available for caddisfly occurrences on the Tonto National Forest.

A mayfly (Fallceon eatoni)

A mayfly (*Fallceon eatoni*): While originally collected over 100 years in northern Sonora, *Fallecon eatoni* was only rediscovered again in 2005 from Salt River Canyon, Gila Co., Arizona (McCafferty 2006), with an additional observation recorded in the San Bernardino Mountains, Cottonwood Canyon, California (Meyer and McCafferty 2008).

No species-specific information is available regarding the necessary ecological conditions for *Fallecon eatoni.* Generally, all mayflies are entirely aquatic in the immature larval stage. The larvae molt numerous times, generally over a short period of time. This is followed by a unique life stage called the subimago in which individuals are winged but sexually immature. These perch along shoreline vegetation between 4 minutes and 48 hours. The adults may only live hours to a few days (NatureServe 2017). Dispersal of mayflies is limited by the short lifespan of gravid females and drainage systems (NatureServe 2017). The mayfly is likely associated with silt, fine sand, gravel, and woody material.

Restricted distribution and possibly low numbers are cited as reasons for concern for this species (McCafferty 2006), however, this suggestion may be somewhat dubious as population trend and distribution for this mayfly are generally unknown and surveys have not been conducted. Generally, mayflies in some areas of North America may be at risk due to existing or impending habitat degradation. Four North American mayflies (*Ephemera compar, Isonychia diversa, Pentagenia robusta, Siphlonurus luridipennis*) have been considered extinct in recent years. (Purdue University Department of Entomology 1995). While no specific threats are known for *Fallecon eatoni*, the aquatic and riparian habitats within the Lower and Upper Salt River zone are considered highly departed. Nonnative, invasive species are widespread and common, and watershed flows and channels have been dramatically altered over time. These desert riparian ecosystems are considered at high risk in the future due to projected drought conditions and increasing water demand from the adjacent metropolitan area. Heavy recreation along some parts of the Salt River may also have an impact on rare aquatic species.

Fossil springsnail (Pyrgulopsis simplex)

Fossil springsnail is a hydrobiid class of snail. NatureServe's rounded global status for this snail is G1 and State of Arizona ranking is S1 (critically imperiled) because the species is known only from a spring near Strawberry, Gila County, along with Fossil Springs, Yavapai County, Arizona (NatureServe 2015). The species is presently listed as sensitive on the Region 3 forester's list (USDA Forest Service 2013) and listed as Tier 1A species of greatest conservation need in Arizona (Arizona Game and Fish Department 2012b). The Fossil springsnail prefers headspring and upper sections of the outflow. The genus *Pyrgulopsis* is generally found on rock or aquatic macrophytes in moderate current at elevations of 4,140 to 4,310 feet. On the Tonto National Forest, the Fossil springsnail is found on the Payson Ranger District. An estimated total of 17.13 acres of Fossil springsnail occupied habitat has been identified on the Tonto National Forest according to data compiled from Forest Service survey efforts and the most recent data from Arizona Game and Fish Department.

Fossil Creek is a designated botanical conservation area and is protected from development with limited access to the area. Snails are typically found on rock or macrophytes and cannot withstand desiccation. Threats to this species include loss or degradation of aquatic habitats due to water development activities, loss of streamside vegetation, and increased sedimentation due to land management activities. Forest management activities that have contributed to habitat degradation include road construction and maintenance, timber management, fire suppression and subsequent stand-replacing fires, and permitted livestock grazing. Management needs include protection of spring source, and periodic monitoring of populations and their habitats (Arizona Game and Fish Department 2003, Stevens and Ledbetter 2014).

This species is a moderate risk of habitat loss due to loss of spring waters that provide the perennial flow to the creek (Arizona Game and Fish Department 2003c). In the Lower Verde zone, watersheds with perennial streams have moderate to high departure from reference condition with 67.5 percent of 6th-level hydrologic unit code watersheds functioning at risk or impaired.

Net-winged midge (Agathon arizonicus)

In Arizona, this species is known from a single occurrence on Workman Creek, Sierra Ancha Mountains, Gila County. It is thought to occur between 6,000 and 9,300 ft elevation in the Pinaleño Mountains (Arizona Game and Fish Department 2003a). On the Tonto National Forest this species is thought to occur in the Sierra Ancha Mountains reoccurring disjointedly in the highlands of southeastern Arizona. A total of 7.72 acres of netwing midge occupied habitat has been identified on the Tonto National Forest according to data compiled from Forest Service survey efforts and the most recent data from Arizona Game and Fish Department.

Habitat for related members of the Blephariceridae family generally occurs in rapid flowing streams and the immediate vicinity. Larvae and pupae are associated with smooth-faced rocks very swift flowing waters. The young are thought to feed on algae and diatoms, but the diet of adults is largely unknown (Arizona Game and Fish Department 2003a).

While the species-specific ecological conditions are not known for this species, Throughout the plan area, 31 percent of riparian areas are classified as unstable while an additional 51 percent are considered impaired. Only 18 percent of streams assessed were considered stable. Workman creek, where this species was identified on the forest, was rated as having low water quality and flows and is functioning at risk.

Information on this species is severely lacking. Classification for the family Blephariceridae is considered provisional and needs review. While considered abundant where found, the distribution of A. arizonicus across Arizona is unknown. Successful identification may be especially difficult if not observed during particular life stages or water levels (Arizona Game and Fish Department 2003a).

While little information is available regarding threats to this species in the plan area or elsewhere, we are not able to show that it is likely secure on the forest. Thus, we have included it in our list of potential species of conservation concern due to its NatureServe ranking, per the guidance in the 2012 planning rule.

Parker's cylloepus riffle beetle (Cylloepus parkeri)

Parker's cyllopeus riffle beetle is only known to occur in in spring-fed Roundtree Canyon and in Tangle Creek, in Bloody Basin in the Tonto National Forest. (R. Johnson 1992). NatureServe's rounded global status for Parker's cyllopeus riffle beetle is G1 (critically imperiled) and state status in Arizona is S1 (critically imperiled) due to its reduced abundance and distribution (NatureServe 2015). A total of 53.53 acres of Parker's cylloepus riffle beetle occupied habitat has been identified on the Tonto National Forest according to data compiled from Forest Service survey efforts and the most recent data from Arizona Game and Fish Department.

The Parker's cylloepus riffle beetle prefers permanent, clean, slow moving small streams, with loose gravelly substrate and very little sand at elevations of 2,850 to 4,000 feet This species in adult stage is a very small, black (sometimes with large reddish spots on the two wing cases), nonswimming beetle living on rocks, sand, and gravel in riffles. Both adults and larvae feed on periphyton, algae, moss, and vegetable material and inhabit permanent, clean, slow-moving, small streams with loose gravelly substrate and very little sand (Arizona Game and Fish Department 2003b). This species requires water with a high oxygen content and is highly sensitivity to pollutants. These factors greatly restrict distribution.

Due to the very restricted distribution of this endemic species, any disturbance to its riparian and aquatic habitat (e.g., drought, wildfire, and overgrazing) could threaten the persistence of the species in the planning unit. Additional threats include development within and outside the Tonto National Forest boundary that result in groundwater depletion. In combination with climate change impacts that alter riparian areas, groundwater depletion can lead to reductions in streamflow and changes in water quality. Management activities that could improve habitat conditions for this beetle include implementing best management practices on projects in known occupied watersheds to reduce or eliminate factors that affect water quality and quantity such as grazing, mining, catastrophic fire, and dispersed recreational activities in riparian zones. Watersheds in the Lower Verde zone with perennial streams have moderate to high departure from reference condition; 67.5 percent of 6th-level hydrologic unit code watersheds are functioning at risk or impaired.

Amphibians Affected Environment

Lowland leopard frog (Lithobates yavapaiensis)

Potential habitat in the plan area for the lowland leopard frog occurs below the Mogollon Rim in riparian areas, particularly in unregulated streams subject to periodic floods. A total of 4,499.37 acres of lowland leopard frog occupied habitat has been identified on the Tonto National Forest according to data compiled from Arizona Game and Fish Department amphibian surveys and other data from the Department.

Stressors on water resources, including drought, fire, and an increased demand for water, are expected to continue into the future. The fire regime condition class III for the Sonoran Palo Verde-mixed cactus desert scrub and semi-desert grasslands ecological response units is 56 percent and 46 percent, respectively. For the upper elevation ecological response units, which can affect riparian areas downstream where this species is found, the fire regime condition class III is high for both ponderosa pine forest (51 percent) and ponderosa pine-evergreen oak (46 percent) ecological response units. Large-scale wildfires are often followed by large-scale scouring events within the fire boundaries. The resulting sediment load could affect large portions of lowland leopard frog populations.

Though currently stable in most of central Arizona, declines and extirpations have occurred due to chytrid fungal infection, nonnative species interactions (bullfrogs, crayfish), changes in the overall hydrologic conditions (for example, flows, flooding, diversions), and scouring from floods following fires. Risk for this species is considered high and will likely increase due to stressors on permanent water sources, disease, nonnative species, and large-scale fire events. The lowland leopard frog has declined significantly in southeastern Arizona, and the threat to species persistence is considered high (C. Akins, Arizona Game and Fish Department, personal communication, 2016).

Fish Affected Environment

Desert sucker (Catostomus clarkia)

This species is found commonly co-existing with the Sonoran Sucker (*C. insignis*) and are stable to declining in different parts of its range (Arizona Game and Fish Department 2002). The NatureServe conservation status is G3 (vulnerable) to S3S4 (apparently secure) at the rounded global and state levels (NatureServe 2015), and the State of Arizona lists the species as 1B Species of Greatest Conservation Need (Arizona Game and Fish Department 2012b). The species is generally common and stable throughout most of its range; however, it has decreased rapidly in the southern portion of its range due to streamflow alteration, increased sedimentation, and nonnative fish predation and competition (Arizona Game and Fish Department 2002).

The desert sucker occurs in the Bill Williams, Salt, Gila, San Francisco, and Verde River drainages in Arizona and New Mexico. This species is found in a variety of large and small desert mountain streams where observed bottom materials consist of sand, rubble, boulders, mud, and bedrock. The desert sucker is characteristic of small to moderately large streams with pool-riffle development. Small adults and young are predominately riffle fish, especially over gravel/rubble bottoms. The desert sucker tends to live more in rapids than in pools, or at least move to swift areas to feed and then move back to pools. Large adult desert suckers are found in pools during the day, moving to riffles and rapids at night and in periods of high turbidity (Arizona Game and Fish Department 2002). Very young individuals live in warm backwaters along the stream, moving into faster waters as juveniles, then into riffles or pool and pool-like areas as adults. Current velocity is variable, ranging from swift waters of the Virgin River in AZ, and montane tributaries of the Gila system to pools or sluggish streams with little current. Preferred temperature of desert suckers from the Virgin River is 17.5 C with temperatures ranging from 10-21 C.

On the Tonto National Forest, Sonora and Desert sucker are present in the Upper and Lower Salt River, Tonto and Lower Verde River. The desert sucker occurs in desert streams at elevations of 1,000 feet up to streams at 6,800 feet. During the daytime, desert suckers use pools, and in the evening, they move into riffles to feed. The desert sucker is found within all ranger districts. A total of 16,493.43 acres of desert sucker occupied habitat has been identified on the Tonto National Forest according to data compiled from Forest Service survey efforts and the most recent data from Arizona Game and Fish Department.

Roundtail chub (Gila robusta)

The taxonomic uniqueness of the roundtail, headwater, and Gila chub in the State of Arizona remains questionable, with final determinations pending review (US Fish and Wildlife Service 2016, 2017). While new decisions on the validity of these species could change the assessment results for Gila chub (*Gila intermedia*) (from currently federally listed as Endangered), it remains federally listed at the time of this assessment.

The status of the roundtail chub (*Gila robusta*) and Gila chub (*Gila nigra*) remains unclear since the proposed listing of both species was withdrawn by the US Fish and Wildlife service on April 6, 2017 (US Fish and Wildlife Service 2016, 2017). For the purposes of this assessment, we treat these two, formally distinct species as a single species complex (*Gila robusta*) due to their similarity in conservation issues and the difficulty in distinguishing populations on the forest.

Roundtail chub have declined in abundance and distribution. The NatureServe global status for Roundtail chub is G3 (vulnerable) and State of Arizona status is S2 (imperiled) (NatureServe 2015), and it is listed as Tier 1A Species of Greatest Conservation Need in Arizona (Arizona Game and Fish Department 2012b). As with many native fish, reductions in range and numbers are likely the result of habitat loss, as well as competition with and predation by nonnative fish species (Arizona Game and Fish Department 2015).

Roundtail chub are widespread in moderate to large rivers of the Colorado River Basin. In Arizona, it still occurs in the mainstem and tributaries (Fossil Creek) to the Verde and Salt Rivers. Roundtail chub are also still thought to occur in the Upper Clear Creek watershed. On the Tonto National Forest, Roundtail chub occur in Upper Salt (Ash, Cherry, Salome); Lower Verde (Fossil, Roundtree Canyon, E. Verde River, Deadman Creeks); and Tonto Basin (Tonto Creek, Spring, Marsh Creeks).

Roundtail chub occupy cool to warm water, mid-elevation streams and rivers where typical adult microhabitat consists of pools up to eight feet deep adjacent to swifter riffles and runs. Cover is usually present and consists of large boulders, tree root wads, submerged large trees and branches, undercut cliff walls, or deep water. Smaller chub generally occupy shallower, low velocity water adjacent to overhead bank cover. Spawning takes place over gravel substrate. Tolerated water temperatures approach 80°F. Broadcast spawning occurs in early summer, often in or near habitats with submerged vegetation. Young chub feed on small insects, crustaceans, and algal films, while older chub move into moderate velocity pools and runs to feed on both terrestrial and aquatic insects along with filamentous algae. Large roundtail chub take small fish, and even terrestrial animals such as lizards that fall into the water (Arizona Game and Fish Department 2015).

Threats to roundtail chub include aquifer pumping, stream diversion, reduction in stream flows, and predation by and competition with nonnative fishes. Tonto National Forest management activities that have contributed to habitat degradation include road construction and maintenance, timber management, fire suppression and subsequent stand-replacing fires, dam construction and stream diversion, and permitted livestock grazing. Management needs include watershed and stream flow protection, restoration of habitats and removal of nonnative fishes (Arizona Game and Fish Department 2015, US Fish and Wildlife Service 2015).

Sonoran sucker (Catostomus insignis)

Sonora sucker (*Catostomus insignis*) Sonora, or Gila sucker, is a large member of the sucker family (Catostomidae) common between 1,000- and 6,500-feet elevation in the Gila, Verde, Bill Williams, and San Francisco River Basins of Arizona and New Mexico. On the Tonto National Forest, this species is found within the Cave Creek, Mesa, Tonto Basin, and Globe Ranger Districts. A total of 4,248.80 acres of Sonora sucker occupied habitat has been identified on the Tonto National Forest according to data compiled from Forest Service survey efforts and the most recent data from Arizona Game and Fish Department.

NatureServe's global and State of Arizona status is G3, S3 (vulnerable) due to small range, decline in some areas, and threats from habitat loss or augmentation and nonnative species predation and competition (NatureServe 2015). The species is not federally listed but is Sensitive on the Region 3 Forester's List (2013) and is a Tier 1B species of greatest conservation need in the State of Arizona (Arizona Game and Fish Department 2012b).

This species uses medium to moderately large streams, at elevations ranging from 500 to 8,800 feet and does not occur in reservoirs. It is usually found in rapids and flowing pools of streams, primarily over bottoms of gravel-rubble, and can sometimes be found with desert sucker (Arizona Game and Fish Department 2002). Both sucker species are adapted to a wide range of temperatures from warmer rivers to trout streams. Sonora sucker also spawns in late winter or early spring on graveled riffles, and hybridization between the two species has been known to occur (Arizona Game and Fish Department 2002).

Further protections from activities that can have adverse impacts to watersheds (i.e., grazing, road and off-road vehicle use, dispersed recreation) are provided to sucker habitat from special areas such as inventoried roadless areas, wild and scenic rivers, and wilderness areas.

Activities that have contributed to habitat degradation include road construction and maintenance, timber management, fire suppression and subsequent stand-replacing fires, dam or waterway alterations (e.g., Salt River projects, water diversions, or groundwater pumping), and permitted livestock grazing. Alteration of historic flow regimes have diminished available habitat. Increased sedimentation can reduce available food sources of periphyton and algae, macroinvertebrate larvae, and can fill interstitial spaces of graveled spawning habitats. In addition, the stocking of nonnative fishes has increased predation, competition and/or introduced or invasive hybridization (Arizona Game and Fish Department 2002).

Reptiles Affected Environment

Bezy's night lizard (Xantusia bezyi)

Bezy's night lizard is a highly endemic species found only in central Arizona. The majority of its range occurs primarily on the Tonto National Forest, found east of the Verde River from the Mazatzals Mountains and Superstition Mountains east to the base of the Pinal Mountains and south across the Gila River to the Galiuro Mountains. Population size for the species is unknown. The lizards occupy crevices in granite boulders in upland Sonoran desert and interior chaparral. Individuals are difficult to view as they are considered rock crevice specialist, and almost always remain hidden (Jones 2009). Their diet consists primarily of ants and other arthropods that occur in the crevices. They are also thought to have a relatively low reproductive output (1 to 2 live young per year). A total of 66.26 acres of Bezy's night lizard occupied habitat has been identified on the Tonto National Forest according to data compiled from Forest Service survey efforts and the most recent data from Arizona Game and Fish Department.

Currently, the ecological response units occupied by the Bezy's night lizard are Mojave-Sonoran desert scrub and interior chaparral. These ecological response units are in moderate and low seral state departure, respectively. Fire regime condition classes for the Mojave-Sonoran desert scrub ecological response unit indicate a high degree of departure, while the interior chaparral ecological response unit is in moderate departure from reference conditions. While the influence of altered fire regimes may or may not affect a crevice dwelling lizard, we suggest that potential direct or cascading effects (e.g., diminished prey base, flooding and erosion, fire-induced mortality, etc.) are worth considering given the very limited distribution of this rare species.

While no specific threats to this species have been identified, the very limited distribution and occurrence of the Bezy's night lizard make it susceptible to a range of stochastic events that might negatively affect persistence in the plan area, thus justifying at-risk status.

Sonoran desert tortoise (Gopherus morafkai)

Approximately 1,016,735 acres of potential habitat for Sonoran desert tortoise occurs on Cave Creek, Globe, Payson, and Tonto Basin Ranger Districts, including approximately 822,197 acres of desert communities and semi-desert grasslands potential natural vegetation types. Approximately twenty percent of potential habitat for the species is in the Four Peaks, Mazatzal, Salome, and Superstition wilderness areas.

On October 5, 2015, the US Fish and Wildlife Service made a finding to remove the Sonoran desert tortoise from the Endangered Species Act candidate list. While the long-term projection of tortoise populations is difficult to predict in the face of climate change and other risks, tortoise populations are currently considered stable (Averill-Murray and Klug 2000, US Fish and Wildlife et al. 2015) (2). Many of the identified threats to tortoise populations are related to loss of habitat due to urbanization; however, such threats are unlikely to impact tortoise numbers on the forest. Human-tortoise interactions have also been suggested to negatively impact tortoise numbers. At high frequencies, such interactions could potentially lead to population level effects; however, such effects have yet to be documented (US Fish and Wildlife Service 2015).

The Tonto National Forest is currently home to some of the densest populations of Sonoran desert tortoise (that is, Sugarloaf Mountain and Mazatzal Mountains) (Averill-Murray and Klug 2000). On October 5, 2015, the tortoise was removed as a candidate species; however, it continues to be managed under a formal candidate conservation agreement for which the Tonto National Forest is one of the signatory agencies. Thus, tortoises on and off the forest are buffered by this multiagency agreement, which the forest will continue to uphold in the future.

Birds Affected Environment

American peregrine falcon (Falco peregrinus)

On the Tonto National Forest, the American peregrine falcon is found in all districts. This species has been documented along the Mogollon Rim, in the Sierra Ancha Mountains, and the Mazatzal Mountains. Optimum falcon habitat is generally considered to be steep, sheer cliffs overlooking woodlands, riparian areas or other habitats supporting avian prey species in abundance at elevations of 400 to 9,000 feet. Suitable nesting sites on rock cliffs have an average height of 200 to 300 feet. Peregrine falcons prey mainly on birds found in wetlands, riparian areas, meadows, parklands, croplands, mountain valleys, and lakes within a 10-to-20-mile radius from the nest site. The American peregrine falcon is found worldwide except Antarctica. It breeds in Arizona wherever sufficient prey is available near cliffs. Areas of spectacular cliffs such as the Mogollon Rim, Grand Canyon, and Colorado Plateau contain most of Arizona's breeding peregrines.

Northern goshawk (Accipiter gentilis)

While the Tonto National Forest has conducted surveys of northern goshawks in conjunction with various forest projects, the resulting data is limited due to relatively low density of birds and the difficulty of detecting them. Most of these observations are of nest occupancies; however, recent studies suggest that using small samples of nest occupancy over relatively short periods to infer population trend and condition can result in imprecise, and possibly biased, results (Reynolds et al. 2017).

While the role of forest management and its effect on the goshawks is an area of active research, there is growing evidence that goshawks are more of a forest generalist and that populations are more resilient to changes in forest condition than previously thought (Andersen et al. 2005, Beck et al. 2011, Beier and Drennan 1997, Beier and Ingraldi 2012, Beier et al. 2008, Drennan and Beier 2003, Hoffman and Smith 2003, Kennedy 1997, Moser and Garton 2009, Reich et al. 2004, Reynolds et al. 2008, Reynolds et al. 2017, Wiens et al. 2006). High-severity fire is a potential risk to goshawk habitat. Large, landscape-level ecological units need to be identified and managed in such a way that all necessary habitat attributes, from nesting sites to foraging areas, are available to support the species at the population level (NatureServe). Trends are difficult to determine due to various methodologies used to track bird populations. Little historical information on goshawk densities exists.

Sulphur-bellied flycatcher (Myiodynastes luteiventris)

Sulphur-bellied flycatchers (*Myiodynastes luteiventris)* breed in the sycamore-lined drainages along the Mogollon Rim and other high elevation mountains on the Tonto National Forest (Corman and Wise-Gervais 2005). These breeding populations are separated by quite some distance, likely making them isolated from one another. The flycatcher breeds in southeastern Arizona and northeastern Mexico south to northern Costa Rica. This species winters in northern South America. On the Tonto National Forest, this bird has been documented on the Payson and Pleasant Valley Ranger Districts. Species records include Sierra Ancha, an individual observed investigating tree cavities near the base of the Mogollon Rim along Christopher Creek, and a calling bird along Fossil Creek west of Strawberry.

The sulphur-bellied flycatcher nests in drainages with tall, broadleaf riparian woodlands with Arizona sycamore. This species also occurs in cool canyons with Arizona alder, Gambel’s oak, box elder, and very scattered conifers. The elevation range for this species is 4,500 to 6,000 feet. A total of 17,731.10 acres of sulphur-bellied flycatcher suitable habitat is present on the Tonto National Forest.

The ecological conditions necessary for the species include drainages with tall, broadleaf riparian woodlands, which translate to the Tonto National Forest’s Cottonwood Group riparian ecological response unit. The Cottonwood Group ecological response unit is not well represented on the Tonto. It is currently undergoing high departure and is projected over the next 100 years to increase slightly in departure (from 68 to 69 percent). The fire regime condition class of the upland habitat adjacent to the Cottonwood Group ecological response unit is class III.

The sulphur-bellied flycatcher is considered an at-risk species on the Tonto National Forest due to the low population numbers, isolated breeding populations, current and future departure of the species’ breeding habitat, and risk of fire extirpating the small, isolated populations on the Tonto.

Yellow-eyed junco (Junco phaeonotus)

Yellow-eyed juncos reach the northern limit of their range on the Tonto National Forest. Currently there is one population of this Mexican species on the Tonto National Forest, located in the Pinal Mountain range. The necessary ecological conditions for the species in that mountain range includes forests containing Douglas fir, white fir, ponderosa pine, and oaks. In addition, the species requires forests that are cooler, wetter, and more shaded, while also requiring groundcover that consists of scattered grass clumps, small shrubs, forbs, ferns, downed trees, and an abundance of leaf litter (Corman and Wise-Gervais 2005).

The preferred habitat falls into the Madrean encinal woodland and mixed conifer-frequent fire ecological response units. These ecological response units are currently departed and expected to continue to be departed in the 100-year projection. The moderate to high departure of vegetative groundcover these ecological response units are experiencing is not beneficial for a junco that forages on the ground. The biggest threat to this species persisting long term on the Tonto National Forest is wildfire. A large wildfire in the Pinal Mountains could greatly reduce the population size and reduce the already limited habitat (about 5 percent of the total acreage on the Tonto National Forest) upon which the junco relies.

If this population is reduced or extirpated from the Pinal Mountains, it is unlikely the species would repopulate that mountain range due to the species’ altitudinal migrations and few vagrant records of this species (Sullivan 2020). Given the junco’s small, isolated breeding population and the increased wildfire risk due to wildfire suppression, this species should be considered at-risk on the Tonto National Forest.

Mammals Affected Environment

Allen’s big-eared bat (Idionycteris phyllotis)

Allen's big-eared bats have been found in a variety of habitats in Arizona, including ponderosa pine, pinyon-juniper, Madrean woodland, white fir forest, and Mohave Desert scrub. The bats are found in extreme southern Nevada, the southern third of Utah, throughout Arizona, the southwestern quarter of New Mexico, and south through the interior of Mexico (O’Shea et al. 2003). While surveys in the planning unit are limited or anecdotal, a few Allen’s big-eared bats have been positively identified on the Tonto. A total of 15.45 acres of Allen’s big-eared bat occupied habitat has been identified on the Tonto National Forest according to data compiled from Forest Service survey efforts and the most recent data from Arizona Game and Fish Department.

Allen's big-eared bats are often associated with water for feeding and drinking. They are most often encountered in ponderosa pine, pinyon-juniper, pine-oak woodland, and riparian habitats above 3,000 feet. Colonies are most often found in rocky places near riparian habitat or woodlands and the bats frequently use mine tunnels for roosting. Maternity colonies of 30 to 150 individuals have been found in mine shafts, boulder piles, lava beds, and beneath the loose bark of large ponderosa pine snags. These bats feed on moths, soldier beetles, dung beetles, leaf beetles, roaches, and flying ants by either catching them in flight or gleaning them from foliage.

Information on the condition of natural cave habitat features is not known in the planning unit; however, vandalism in caves, closures of man-made habitat (that is, mines), and loss of old snags may threaten maternity roosts. Active mining and recreation at roost sites is considered a potential threat to colonies of Allen’s big-eared bats. While cave areas on the Tonto are regularly gated to allow bat entry while excluding human entry, it is unclear whether this species accepts such mine gates. In forested habitat, it is thought roosting habitat may also be limiting (O’Farrell et al. 2005).

These bats are most commonly associated with cottonwood riparian ecological response units. Overall cottonwood riparian areas are impaired due to hydrologic changes resulting a decline of pulsing floods that help establish sediment terraces and provide a base for seed regeneration. As a result, these areas are transitioning to single-age, older cottonwood galleries with little to no regeneration. In addition, the 6th-level hydrologic unit code watersheds (Upper Salt, Lower Salt, Lower Verde, Middle Gila, and Tonto Basin) are functioning at risk or impaired greater than 65 percent, depending on the watershed.

Pale Townsend's big-eared bat (Corynorhinus townsendii pallescens)

In Arizona, pale Townsend's big-eared bat summer-day roosts are found in caves and mines from desert scrub up to woodlands and coniferous forests. Night roosts may often be in abandoned buildings. In winter, this species hibernates in cold caves, lava tubes and mines mostly in uplands and mountains from the vicinity of the Grand Canyon to the southeastern part of the state. Habitat used is ponderosa pine with presence and regeneration of large snags and/or dead and dying trees with loose bark; cavity-forming rock; dispersion and size of openings and meadows within ponderosa pine, mixed-conifer, and pinyon-juniper with diverse vegetative herbaceous ground cover and species composition to support prey items. Forest edges, pools, tanks, and openings with wet ground also support prey. The pale Townsend's big-eared bat is found at elevations of 550 up to 7,520 feet.

On the Tonto National Forest, pale Townsend's big-eared bats occur within the Globe, Mesa, Payson, Pleasant Valley, and Tonto Basin Ranger Districts. Documented records include Sorghum Hill within Payson Ranger District, 1 mile southeast of Tejano Spring within Mesa Ranger District, Middle Water Spring within Tonto Basin Ranger District, the Sierra Ancha Wilderness, and near Wolf Spring within Pleasant Valley Ranger District. A total of 114.06 acres of pale Townsend's big-eared bat occupied habitat has been identified on the Tonto National Forest according to data compiled from Forest Service survey efforts and the most recent data from Arizona Game and Fish Department.

Spotted bat (Euderma maculatum)

The spotted bat is found in a variety of habitats from low desert to high desert, riparian areas, and conifer forests at elevation range of 110 to 8,670 feet. In Arizona, this species is mostly collected in dry, rough desert scrub with a few captured or heard with acoustic detection equipment in ponderosa pine forest. Roost characteristics and site localities are poorly known, but limited observations suggest this bat prefers to roost in crevices and cracks in cliff faces. Spotted bats have a disjunct distribution and are rarely observed. Threats to populations could include urban expansion (off the forest), disturbance of cliff roosting habitat, woody encroachment of high elevation meadows, pesticides, improper livestock grazing, or pest control operations.

Western red bat (Lasiurus blossevilli)

While surveys within the plan area are limited, the western red bat has been detected. These bats are solitary animals who prefer riparian areas dominated by walnuts, oaks, willows, cottonwoods, and sycamores to roost in the tree foliage. Favored roosts are where trees have a dense canopy above and branches do not obstruct the bat's flyway below.

While population data for the western red bat on the Tonto National Forest is generally not available, they appear to have declined markedly throughout the west. The decline is attributed to the loss of lowland riparian forests due to a lack of regeneration from hydrological alteration of watersheds (O'Shea and Bogan 2003). These bats are associated with the Cottonwood Riparian ecological response unit, which is currently rated as having impaired function. Hydrologic changes have decreased pulsing floods that help establish sediment terraces and provide a base for seed regeneration. As a result, cottonwood riparian areas are becoming single-age, older cottonwood galleries with little to no regeneration. There has been a sharp decline in cottonwoods in the reservoir systems in the planning unit due to the change in hydrologic regime where periodic flushing on rivers and streams is impeded by dams. In addition, the 6th-level hydrologic unit code watersheds (Upper Salt, Lower Salt, Lower Verde, Middle Gila, and Tonto Basin) are functioning at risk or impaired greater than 65 percent, depending on the watershed.

Threats to the riparian habitat used by the western red bad include drought, fire, and an increased demand for water. Water developments (both within and outside of forest boundaries) often result in groundwater depletion, ultimately influencing surface water in many riparian systems. While these stressors are difficult to quantify, they will likely result in further declines in availability and quality of riparian habitat, and in the riparian insect diversity and density that is a main food source for these bats. Due to the moderate to high percentage from departure of riparian ecological response units and subwatersheds across the Tonto, threat to this species' persistence is considered high.

Environmental Effects[15]

Effects on Occupied and Unoccupied Habitat Essential for Recovery: Comparison of Alternatives[16]

Affected Environment

Many ecological response units on the forest are departed from reference conditions[17]. In a number of these vegetative communities, this has occurred due to changes in historical fire regimes. Woodland and forested ecological response units on the forest generally evolved to experience frequent fire, however, historical fire exclusion has resulted in larger patch sizes, high stand densities (trees and shrubs), a loss of grass and forb diversity, have an overall reduction of herbaceous cover, and are more prone to atypical wildfires (generally high severity fires). Also, these ecological response units have lower structural diversity where, on average, more acres are in closed-canopy-states (specifically forested ecological response units). These changes can negatively impact wildlife species as they generally benefit from a diversity of structural attributes (canopy complexity, forest patchiness, etc.).

Desert ecosystems on the Tonto National Forest (Mojave Sonoran desert scrub and Sonora-Mojave mixed salt desert scrub ecological response units) make up a significant proportion of the forest. These systems largely evolved without fire as a key ecological process and therefore many species are not fire adapted (such as succulents). Historically, when fires did occur, negative impacts were minimal because naturally occurring fuel loads (patches of vegetation) were separated by large un-vegetated interspaces that limited the spread of fires. Past land use practices, such as the increase in forage for grazing during the late 19th and early 20th centuries, and other activities (ground disturbance activities, off road vehicle use, roads and trail construction and use) have influenced the introduction of exotic and invasive species and increased wildfires in these systems. As exotics, such as annual grasses and forbs, increase in these systems, fuel loads shift from discontinuous to contiguous patches and result in higher wildfire risk.

Native grasses have been replaced with exotic and invasive species for many ecological response units on the forest which lowers site productivity, reduces soil productivity and are not as effective in the prevention of erosion (especially during droughts) or as productive for forage. Soil loss can lead to shifts in species composition with increases in shallow rooted grasses which are less effective in stabilizing soils. These shifts and increases in bare soil can lead to the increased chance of invasive plant infestations and lower biodiversity.

[15] All assumptions and methods used for this analysis can be found in volume 4, appendix B of the environmental impact statement.
[16] For the comparison of expected effects tables in this section, text in cells describe movement towards or away from desired conditions. An asterisk indicates a faster rate of change. Two asterisks indicates the fastest rate of change.
[17] A complete description of the existing condition of ecological response units on the Tonto National Forest, along with the analysis of the effects, by alternative, to these units can be found in the Ecological Response Units section of this environmental impact statement. The following analysis takes those conclusions as part of the basis for this analysis.

Summary and Comparison of Environmental Effects for all Ecological Response Units

Alternative A

Generally, frequent fire ecological response units would remain highly departed under this alternative, increasing risks for species associated with these systems. Many regional forester sensitive species that live in these habitats are at-risk from uncharacteristic fires, either directly from high severity fire effects or indirectly from the lack of diverse structural elements that come from dense, even-age stands. Canopy cover would also be greatest under this alternative. Ground cover and erosion are greater risks for most ecological response units, especially in semi-desert grasslands. Other lower elevation ecological response units would make little progress towards desired conditions as the current plan does not contain many specific standards, guidelines, or objectives for them. Fire management in desert systems would seek to minimize impacts, but not focus on suppression.

Alternative A also includes plan components specifically for northern goshawks that direct the forest to survey for and establish post-fledging family areas and nest areas. These areas are subject to guidelines that limit human disturbance during the breeding season (March 1 through September 30), provide for greater canopy cover and smaller opening size, and prioritize preferred treatment methods (e.g., prescribed burning). While these guidelines specifically provide for fledging and nesting habitats, alternative A is ultimately less effective at addressing the primary threat of large, high severity fires due to the lower rate of treatments.

Alternative B

Fire regimes and seral state departures for frequent fire forest improve significantly under this alternative. Woodland ecological response units would also improve but remain slightly departed. An overall decrease in canopy cover allows for increased vegetative cover and biodiversity, which in turn adds foraging habitat for many species that prefer multi-age stands. Increased objectives for treating invasive species also contributes to better habitat conditions for many regional forester sensitive species, especially in low desert systems where these contribute to increased risk of fire.

Alternative C

The effects of alternative C on most ecological response units would be similar to those in alternative B; however, the primary reliance on fire as the key restoration tool may challenge implementation efforts when accounting for burn windows. There would be no mechanical treatments in woodlands and these systems would remain departed as would semi-desert grasslands. Desert ecological response units would maintain low departure, but undesirable fire and invasive species are likely to be reduced with treatments. Overall, this alternative does a great deal to improve important habitats for regional forester sensitive species.

Alternative D

This alternative treats substantially fewer acres in frequent fire and wooded systems, largely due to the cost of focusing primarily on mechanical treatments. Without fire, maintaining treatments would be more costly, and repeated entry by mechanical equipment would likely lead to increased impacts to soils and vegetation. Desert ecological response units would likely remain at lower departure and in similar conditions as in the other alternatives. This alternative is generally leaves more ecological response units in higher departure and at greater risk. Regional forester sensitive species struggling or at risk of departed fire regimes or even-aged/closed canopy conditions may be reduced or extirpated at some sites. Uncharacteristic fire effects may threaten species with limited distributions.

Similar to alternative A, this alternative would include guidelines that direct the forest to identify post-fledging family areas and nest areas for northern goshawks. The alternative also includes specific desired conditions for vegetation post-fledging family areas and direction to minimize human presence in these areas during the breeding season. While such guidance is likely to help reduce disturbance to breeding goshawks, it is unclear that such disturbances are likely drivers in goshawk population and reproduction (Grubb et al. 2013; Rodriguez et al. 2016). Because large, high severity fire and severe droughts are considered primary threats to goshawk persistence (Reynolds et al. 2017), alternative D does not address this concern as effectively as alternatives B and C due to the lower rate of treatment.

Conclusion

Because ecosystem integrity and diversity are often tied, the health of vegetative communities, including an assessment of vegetative characteristics by alternative, provides a coarse-filter insight into the habitat scenarios for each ecological response unit and associated regional forester sensitive species. On average, alternative B is the most efficient and speedy option for moving towards desired conditions for all the variables considered. It is likely to contribute as well and frequently better than other alternatives. The main exception, semi-desert grasslands, is projected to move away from away from desired conditions in all alternatives. Though several regional forester sensitive species are associated with these systems, none appear entirely dependent on grasslands.

Alternative C is the next most likely alternative to contribute to ecosystem integrity and diversity, and almost all ecological response units were projected to move towards desired conditions in all categories. Alternative D also moves most ecological response units towards desired conditions, though likely at a slower pace than B and C. For a few systems (i.e., juniper grass, pinyon-juniper, and Madrean encinal woodland), alternative D is projected to result in further departure for all the characteristics analyzed. Alternative A is the least likely to provide ecosystem integrity and diversity based on the vegetation and fire analysis.

Summary and Comparison of Environmental Effects by Ecological Response Unit

The following content (table 180 through table 192) summarizes the analysis for each of the ecological response units found on the Tonto National Forest, and is a more detailed look at the summarized content above. Each description includes a projected estimate of whether an ecological response unit moves towards or away from desired conditions per each of the alternatives. Five key ecosystem characteristics are evaluated, including: 1) vegetation structure/seral state proportion, closed versus open conditions; 2) grasslands, herbaceous, and ground cover; 3) fire regime; 4) patch size; and 5) ecosystem function.

Following each ecological response unit is a list of associated regional forester sensitive species which depend on the integrity of the corresponding ecosystems. For the complete assessment of ecological response units by alternative, please see the section Ecological Response Units in volume 1 and Resource Assumptions and Methods for Vegetation Ecological Response Units and Fire and Fuels (volume 4, appendix B).

Desert Ecological Response Units

Table 180. Comparison of expected effects to desert ecological response units for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Towards	Towards	Towards
Patch size	No Change	No Change	No Change	No Change
Fire regime	Away	Towards	Towards	Towards
Grasslands, herbaceous, and ground cover	Away	Towards	Towards	Towards
Ecosystem Function	Away	Towards	Towards	Towards

Regional forester sensitive species associated with desert ecological response units: Allen's big-eared bat, Bezy's night lizard, Fish Creek rock daisy, Hohokam agave, horseshoe deer vetch, mapleleaf false snapdragon, pale Townsend's big-eared bat, Pima Indian mallow, Ripley wild buckwheat, Rusby's milkwort, Salt River rock daisy, Sonoran desert tortoise, Tonto Basin agave, and Verde breadroot.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are generally predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. It is unclear, however, that the current 1985 forest plan addresses desert ecological response units sufficiently enough to provide habitat required for recovery of these species.

Interior Chaparral (IC)

Table 181. Comparison of expected effects of each alternative on interior chaparral

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards	Towards	Towards
Patch size	Towards	Towards	Towards	Towards
Fire regime	Towards	Towards	Towards	Towards
Grasslands, herbaceous, and ground cover	Towards	Towards	Towards	Towards
Ecosystem Function	Towards	Towards	Towards	Towards

Regional forester sensitive species associated with interior chaparral: Aravaipa sage**,** Bezy's night lizard, Fish Creek fleabane, Hohokam agave, pale Townsend's big-eared bat, Salt River rock daisy, Sierra Ancha fleabane, Tonto Basin agave, and Toumey groundsel.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species.

Semi-Desert Grasslands (SDG)

Table 182. Comparison of expected effects to semi-desert grasslands for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Away	Away	Away
Patch size	Away	Away	Away	Away
Fire regime	Away	Away	Away	Away
Grasslands, herbaceous, and ground cover	Away	Away	Away	Away
Ecosystem Function	n/a	n/a	n/a	n/a

Regional forester sensitive species associated with semi-desert grasslands: pale Townsend's big-eared bat, Salt River rock daisy

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because semi-desert grasslands are predicted to move away from desired conditions, it is unclear if any of the proposed alternatives will provide habitat required (at least in this particular ecological response unit) for recovery of these species. For the species listed above, none are habitat specialist focusing on semi-desert grasslands and are not limited to this ecological response unit. Thus, we expect that recovery may well take place in other habitats provided on the forest. However, moving semi-desert grasslands towards desired conditions may not be within the capacity of the forest at this time.

Pinon Juniper Woodland (PJO)

Table 183. Comparison of the expected effects (movement towards or away from desired conditions) of each alternative on pinon juniper woodland

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards	Towards	Towards
Patch size	Away	Towards	Towards	Towards
Fire regime	No Change	Away	Away	Away
Grasslands, herbaceous, and ground cover	Away	Towards	Towards	Towards
Ecosystem Function	No Change	No Change	No Change	No Change

Regional forester sensitive species associated with pinon juniper woodland (PJO): Allen's big-eared bat, Mt. Dellenbaugh sandwort, and pale Townsend's big-eared bat.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are generally predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. It is unclear, however, that the current 1985 forest plan addresses pinon juniper woodland sufficiently enough to provide habitat required for recovery of these species. For species that may be impact by fire in these systems, the threat is likely to remain; none are habitat specialist focusing on pinon juniper woodland and are not limited to this ecological response unit. Thus, we expect that recovery may well take place in other habitats provided on the forest.

Juniper Grass (JUG) and Pinyon-Juniper Grass (PJG)

Table 184. Comparison of expected effects (movement towards or away from desired conditions) to juniper grass for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards*	Towards	Towards
Patch size	Away	Towards*	Towards	Away
Fire regime	Away	Towards*	Towards	Away
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards	Away
Ecosystem Function	Away	Towards*	Towards	Away

Table 185. Comparison of expected effects (movement towards or away from desired conditions) to pinyon-juniper grass for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards*	Towards	Away
Patch size	Away	Towards*	Towards	Away
Fire regime	Away	Towards*	Towards	Away
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards	Away
Ecosystem Function	Away	Towards*	Towards	Away

Regional forester sensitive species associated with juniper grass (jug) and pinyon-juniper grass (PJG): northern goshawk, pale Townsend's big-eared bat, Salt River rock daisy, and Tonto Basin agave.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. It is unclear, however, that the current 1985 forest plan or alternative D address juniper grass and pinyon-juniper grass sufficiently enough to provide habitat required for recovery of these species.

Madrean Encinal Woodland (MEW) and Madrean Pinyon-Oak (MPO)

Table 186. Comparison of expected effects (movement towards or away from desired conditions) to Madrean encinal woodland by alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Towards*	Towards	Away
Patch size	Away	Towards*	Towards	Away
Fire regime	Away	Towards*	Towards	Away
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards	Away
Ecosystem Function	Away	Towards*	Towards	Away

Table 187. Comparison of expected effects (movement towards or away from desired conditions) to Madrean pinyon oak for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Towards*	Towards	Away
Patch size	Away	Towards*	Towards	Away
Fire regime	Away	Towards*	Towards	Away
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards	Away
Ecosystem Function	Away	Towards*	Towards	Away

* Indicates a faster rate of change. Two asterisks indicates the fastest rate of change.

Regional forester sensitive species associated madrean encinal woodland and madrean pinyon-oak: Aravaipa sage, Blumer's dock, Toumey groundsel, and yellow-eyed junco.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. It is unclear, however, that the current 1985 forest plan or alternative D address Madrean encinal woodland sufficiently enough to provide habitat required for recovery of these species.

Pinyon–Juniper Evergreen Shrub (PJC)

Table 188. Comparison of the expected effects of each alternative on pinyon-juniper evergreen shrub

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards**	Towards*	Towards
Patch size	No Change	Towards	Towards	Towards
Fire regime	Away	Towards	Towards	Towards
Grasslands, herbaceous, and ground cover	Away	Towards*	Towards**	Towards
Ecosystem Function	Away	Towards	Towards	Towards

*Indicates a faster rate of change. Two asterisks indicate the fastest rate of change.

Regional forester sensitive species associated pinyon–juniper evergreen shrub: Allen's big-eared bat, Aravaipa sage, Fish Creek rock daisy, northern goshawk, pale Townsend's big-eared bat, Sierra Ancha fleabane, and Toumey groundsel.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. It is unclear, however, that the current 1985 forest plan addresses pinyon-juniper evergreen shrub sufficiently enough to provide habitat required for recovery of these species.

Ponderosa Pine–Evergreen Oak (PPE)

Table 189. Comparison of expected effects to ponderosa pine-evergreen oak for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards**	Towards*	Towards*
Patch size	Towards	Towards**	Towards*	Towards*
Fire regime	Towards	Towards**	Towards*	Towards
Grasslands, herbaceous, and ground cover	Towards	Towards**	Towards*	Towards*
Ecosystem Function	Towards	Towards**	Towards*	Towards

*Indicates a faster rate of change. Two asterisks indicate the fastest rate of change.

Regional forester sensitive species associated with ponderosa pine – evergreen oak: Allen's big-eared bat, Arizona bugbane, Blumer's dock, Mt. Dellenbaugh sandwort, northern goshawk, pale Townsend's big-eared bat, Senator Mine alumroot, Sierra Ancha fleabane, and Toumey groundsel.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. The action alternatives, however, are considered most efficient at contributing essential habitat conditions.

Ponderosa Pine Forest (PPF)

Table 190. Comparison of expected effects to ponderosa pine forest for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards**	Towards*	Towards*
Patch size	Towards	Towards**	Towards*	Towards*
Fire regime	Towards	Towards**	Towards*	Towards
Grasslands, herbaceous, and ground cover	Towards	Towards**	Towards*	Towards*
Ecosystem Function	Towards	Towards**	Towards*	Towards

*Indicates a faster rate of change. Two asterisks indicate the fastest rate of change.

Regional forester sensitive species associated with ponderosa pine forest: Allen's big-eared bat**,** Blumer's dock, Mt. Dellenbaugh sandwort, northern goshawk, pale Townsend's big-eared bat, and Senator Mine alumroot.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. The action alternatives, however, are considered most efficient at contributing essential habitat conditions.

Mixed Conifer with Frequent Fire (Dry Mixed Conifer [MCD])

Table 191. Comparison of expected effects to mixed conifer with frequent fire (dry mixed conifer) for each alternative

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Towards	Towards**	Towards*	Towards*
Patch size	Towards	Towards**	Towards*	Towards*
Fire regime	Towards	Towards**	Towards*	Towards
Grasslands, herbaceous, and ground cover	Towards	Towards**	Towards*	Towards*
Ecosystem Function	Towards	Towards**	Towards*	Towards

*Indicates a faster rate of change. Two asterisks indicate the fastest rate of change.

Regional forester sensitive species associated with mixed conifer with frequent fire: Arizona bugbane, Blumer's dock, northern goshawk, Senator Mine alumroot, and yellow-eyed junco.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. The action alternatives, however, are considered most efficient at contributing essential habitat conditions.

Mixed Conifer with Aspen (Wet Mixed Conifer) (MCW)

Table 192. Comparison of the expected effects of each alternative on mixed conifer with aspen (wet mixed conifer)

Ecosystem Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Seral state distribution, open / closed states	Away	Towards	Towards	Towards
Patch size	Away	Towards	Towards	Towards
Fire regime	Away	Towards	Towards	Towards
Grasslands, herbaceous, and ground cover	Away	Towards	Towards	Towards
Ecosystem Function	Away	Towards	Towards	Towards

*Indicates a faster rate of change. Two asterisks indicate the fastest rate of change.

Regional forester sensitive species associated with mixed conifer with aspen (MCW): Arizona bugbane, Blumer's dock, northern goshawk, Senator Mine alumroot, and yellow-eyed junco.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. It is unclear, however, that the current 1985 forest plan addresses mixed conifer with aspen sufficiently enough to provide habitat required for recovery of these species.

Riparian Areas, Seeps, Springs, Wetlands, and Riparian Management Zones (RMZ)

Table 193. Regional forester sensitive species associated with riparian areas, seeps, springs, wetlands, and riparian management zones

Common Name	Scientific name	Taxonomic group
A caddisfly	*Wormaldia planae*	invertebrate
A mayfly	*Fallceon eatoni*	invertebrate
Allen's big-eared bat	*Idionycteris phyllotis*	mammal
Aravaipa sage	*Salvia amissa*	plant
Aravaipa woodfern	*Thelypteris puberula*	plant
Arizona bugbane	*Cimicifuga arizonica (syn. Actaea arizonica)*	plant
Blumer's dock	*Rumex orthoneurus*	plant
Chihuahuan sedge	*Carex chihuahuensis*	plant
Chiricahua Mountain alumroot	*Heuchera glomerulata*	plant
Cochise sedge	*Carex ultra (syn. C.spissa var. ultra)*	plant
Desert sucker	*Catostomus clarkii*	fish
Fish Creek fleabane	*Erigeron piscaticus*	plant
Fossil springsnail	*Pyrgulopsis simplex*	invertebrate
Gila rock daisy	*Perityle gilensis var. gilensis*	plant
Headwater chub	*Gila nigra*	fish
Hohokam agave	*Agave murpheyi*	plant
Lowland leopard frog	*Lithobates yavapaiensis*	amphibian
Mapleleaf false snapdragon	*Mabrya acerifolia*	plant
Net-winged midge	*Agathon arizonicus*	invertebrate
Northern goshawk	*Accipiter gentilis*	bird
Parker's cylloepus riffle beetle	*Cylloepus parkeri*	invertebrate
Roundtail chub	*Gila robusta*	fish
Salt River rock daisy	*Perityle gilensis var. salensis*	plant
Senator Mine alumroot	*Heuchera eastwoodiae*	plant
Sierra Ancha fleabane	*Erigeron anchana*	plant
Sonoran sucker	*Catostomus insignis*	fish
Sulphur-bellied flycatcher	*Myiodynastes luteiventris*	bird
Western barking frog	*Craugastor augusti cactorum*	amphibian
Western red bat	*Lasiurus blossevilli*	mammal

Table 194. Resource Indicator by alternative for riparian areas, seeps, springs, wetlands, and riparian management zones

Resource Indicator	Alternative A	Alternative B	Alternative C	Alternative D
Ability to accomplish restoration goals/objectives	Low	High	High	Low – Moderate
Effectiveness of riparian management	Moderate	High	High	Moderate
Management emphasis for rare and unique riparian ecosystems	Moderate	High	High	Low
Movement towards and rate of achieving desired conditions	Towards *	Towards **	Towards ***	Towards *

*Rate of achieving desired conditions is expressed by plus symbols: slow (*), moderate (**), and fast (***)

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. Alternatives B and C, however, are expected to be the most efficient for achieving desired conditions at the fastest rate.

Watersheds and Water Resources (WAT)

Table 195. Regional forester sensitive species associated with watersheds and water resources

Common Name	Scientific name	Taxonomic group
A caddisfly	*Wormaldia planae*	invertebrate
A mayfly	*Fallceon eatoni*	invertebrate
Allen’s big-eared bat	*Idionycteris phyllotis*	mammal
Aravaipa sage	*Salvia amissa*	plant
Aravaipa woodfern	*Thelypteris puberula*	plant
Arizona bugbane	*Cimicifuga arizonica (syn. Actaea arizonica)*	plant
Blumer's dock	*Rumex orthoneurus*	plant
Chiricahua Mountain alumroot	*Heuchera glomerulata*	plant
Cochise sedge	*Carex ultra (syn. C.spissa var. ultra)*	plant
Desert sucker	*Catostomus clarkii*	fish
Fish Creek fleabane	*Erigeron piscaticus*	plant
Fossil springsnail	*Pyrgulopsis simplex*	invertebrate
Headwater chub	*Gila nigra*	fish
Lowland leopard frog	*Lithobates yavapaiensis*	amphibian
Net-winged midge	*Agathon arizonicus*	invertebrate
Parker’s cylloepus riffle beetle	*Cylloepus parkeri*	invertebrate
Pima Indian mallow	*Abutilon parishii*	plant
Roundtail chub	*Gila robusta*	fish
Sierra Ancha fleabane	*Erigeron anchana*	plant
Sonoran sucker	*Catostomus insignis*	fish
Western red bat	*Lasiurus blossevilli*	mammal

Alternative A – No Action

The 1985 forest plan identifies increasing water yield by vegetation treatments as a goal but lacks direction on maintaining or improving other aspects of water quantity. Water quality improvement projects would only occur on an opportunity basis. The current plan also lacks direction on groundwater stewardship and watershed management during drought conditions. And does not provide direction for management of resources in response to climate change.

Alternative B – Proposed Action

This alternative is most effective at addressing uncharacteristic wildfires that burn with high severity and can result in greater than normal peak flows, erosion, and water quality impacts (DeBano et al. 1998). These changes in turn can cause stream channels within and below burned areas to aggrade, incise, or widen. Reducing the likelihood of uncharacteristic wildfires benefits watershed condition (e.g., water quality, aquatic habitat and biota, Soil erosion and productivity, and forest cover). Watershed condition improvement could be greater in this alternative than in Alternative A because riparian restoration activities would be more focused in specific sixth code watersheds than sporadically across the forest. Improvement would be at a slower rate than in alternative C and would be greater than alternative D.

This alternative also proposes management areas that may serve to protect watersheds, though it does not propose as much recommended wilderness as in alternative C. It also provides some added requirements on the removal of mineral materials from riparian areas, which is likely to positively influence water resources.

Alternative C

This alternative is likely to see an increased rate of improvement in riparian area condition compared to alternative B and a greater improvement than alternatives A and D. Closing vacant allotments to grazing where soil, riparian, vegetation, and/or channel conditions are currently in poor condition should help improve watershed condition and water quality. Favoring primitive recreation may have a positive impact and increases in proposed special management areas is likely to contribute to better watershed and water resource conditions. Prohibition of mineral materials (sand and gravel) withdrawal may help prevent negative impacts to water resources.

Alternative D

Of the action alternatives, this alternative provides the least protection for water resources and watershed condition. This alternative proposes the fewest watershed treatments of the alternatives, does not propose to decommission roads, restores the smallest number of acres of riparian habitat, does not propose to restore or maintain springs, and does not propose to remove degrading activities from non-functioning riparian areas. Reduction in these activities results in the slowest rate of improvement in watershed conditions and water quality and may even result in some degradation if the condition of riparian areas declines.

Table 196. Comparison of the expected effects of each alternative on watersheds and water resources

Resource	Alternative A	Alternative B	Alternative C	Alternative D
Watersheds and water resources	Away	Towards*	Towards**	Towards

*Indicates a faster rate of change. Two asterisks indicate the fastest rate of change.

Determination of Effect

The forest plan does not propose to increase or decrease the quantity of occupied or unoccupied habitat; however, plan direction may lead to projects that do impact habitat quality. Although some projects may involve some short-term, negative impacts, because all action alternatives are predicted to move this habitat towards desired conditions, they are considered to have a beneficial effect for the associated regional forester sensitive species. It is unclear, however, that the current 1985 forest plan addresses watersheds and water resources sufficiently enough to provide habitat required for recovery of these species.

Cumulative Effects

Four Forest Restoration Initiative

The Four Forest Restoration Initiative (4FRI) includes 2.4 million acres of northern Arizona ponderosa pine forests and associated ecosystems, approximately 300,000 acres of which are on the Tonto National Forest. The intent of the initiative is to restore the area to healthy resilient forests that support natural fire regimes and reduce the risk of uncharacteristically severe wildfire, and provide quality habitat that supports healthy populations of native plants and animals. This effort is very likely to improve many departed habitats for wildlife, primarily in frequent fire systems. This long-term and large-scale project is likely to restore many structural components considered beneficial to species and work to reduce the risk of uncharacteristically severe fire.

Travel Management

The Travel Management Plan proposes to decommission 1,292 miles of motorized routes on the forest. Eventual decommissioning of these routes would reduce the miles of roads within a three-hundred-foot buffer distance of perennial, intermittent and ephemeral streams, and lakes. It would reduce the miles of roads within riparian areas and the number of crossings of perennial, intermittent and ephemeral streams. It would also reduce motorized route density on the forest to. Reduction in the number of miles of motorized routes is likely to reduce impacts to species sensitive to direct or indirect impacts of roads and motorized travel.

Mining Activities

Mineral prospecting and mining is an activity within and near the Forest that has occurred for many years. Mineral prospecting by itself has only small surface disturbing activities but mining economical ore deposits can affect larger areas with tailings ponds, leach pads, power, water and other mining infrastructure. Impacts to surface water quantity and quality and groundwater quality and quantity as well as water-dependent resources have occurred in the past and may occur in the future. The Resolution Copper Project near Superior is currently being evaluated in an environmental impact statement and an environmental impact statement is also being prepared for expansion of the Pinto Valley Mine near Miami-Globe. These projects have the potential to create surface disturbance and affect water resources. Other mineral exploration activities are occurring on the Forest. If economically viable ore deposits are discovered and developed, they also have the potential to affect watershed conditions and water resources on the forest.

Tribal Management Activities

The forest is bordered on the east by the Fort Apache and San Carlos Indian Reservations. Watersheds drain primarily from the forest to the reservations. The San Carlos reservation is developing a plan for reducing fuel loadings on both the reservation and the forest in a collaborative process with the Forest. Implementation should reduce fuel loading in the thumb area of the Tonto as well as on portions of the San Carlos Reservation bordering the Tonto. Fuel management efforts also occur on the Fort Apache Reservation. These efforts should benefit and complement fuel reduction efforts on the forest and benefit watershed conditions and help reduce the risk of uncharacteristically severe fire.

Population Growth

The Phoenix metropolitan area is projected to grow rapidly in the near future. As such, it is likely that the number of visitors to the forest will also increase. The increasing footprint from recreationist and other forest users is likely to have an impact on regional forester sensitive species on the forest. Disturbances can take the form of habitat degradation, direct mortality, or behavior disturbance. Simultaneously, resources for managing current and future influxes of visitors is limited, increasingly the likelihood of strain on many species.

Population growth may also impact watershed and water resources as the demand increases over time. This is already a vitally strained resource for many species in a largely arid environment. In the face of a warming climate, the strain on this natural resource is likely to become more intense over time.

Climate Change

In general, most climate modelers agree that the Southwest is trending toward prolonged drought. Future potential ecological effects in the Southwest may include an increase in more intense disturbance events such as wildfires, monsoons, and wind. Changing ecological conditions could provide greater opportunities for invasion by nonnative species and disease with the potential to negatively impact various taxa. General trends toward increased moisture deficit could limit overall forest productivity and associated changes in vegetation patterns could affect overall distribution and range of plant and animal species. Cumulatively these factors would likely impact biodiversity, however to what extent is currently uncertain. (Periman 2008, Periman et al. 2009 and references therein).

Migratory Birds, Bald, and Golden Eagles

Executive Order 13186 (January 10, 2001) requires federal agencies to consider management impacts to migratory birds to further the purposes of the Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and other laws. Federal agencies need to identify whether unintentional take will occur, and if so, whether such take would have a measurable negative effect on migratory bird populations. Take is defined to mean "… to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR 10.12). Removal or destruction of vegetation is not considered a taking. Executive Order 13186 imposes procedural requirements on project level analyses for migratory birds.

Affected Environment

Migratory birds (including eagles protected under the Bald and Golden Eagle Protection Act) that may be found on the Tonto National Forest are:

Bald eagle
Bendire's thrasher
Black throated sparrow
Black-chinned sparrow
Black-throated gray warbler
Burrowing owl
Clark's grebe
Common black hawk
Costa's hummingbird
Elf owl
Gila woodpecker
Gilded flicker
Golden eagle
Grace's warbler
Grasshopper sparrow
Gray vireo
Lark bunting
Lawrence's goldfinch
LeConte's thrasher
Lewis's woodpecker
Long-billed curlew
Marbled godwit
Mexican whip-poor-will
Phainopepla
Pinyon jay
Red-faced warbler
Rufous hummingbird
Rufous-winged sparrow
Varied bunting
Virginia's warbler
Willet

Environmental Effects[18]

Alternative A Effects

The current forest plan does not mention migratory birds. Therefore, all protective direction for the species listed by necessity would come from outside the forest plan. Generally, this would be considered sufficient for evaluating unintentional take at the project level, but habitat planning in the 1985 forest plan is generally not specific enough to make measurable gains in many of the variables important to the species listed above. Eagles and their habitat are addressed in the forest plan; direction generally focuses on improving habitat where they are known to occur. This approach is likely helpful to the species; however, bald eagles have increased in recent years and expanded into some less traditional habitats. This is not addressed in the no-action alternative.

Alternative B Effects

The proposed action seeks to balance a variety of uses while still promoting ecosystem diversity and integrity. It proposes much additional guidance on managing habitats and programs in a manner that would benefit. Future projects may result in unintentional take; however, long-term projections on habitat are projected to improve ecological conditions for most species. In particular, this alternative focuses on

[18] All assumptions and methods used for this analysis can be found in volume 4 of the environmental impact statement, appendix B.

prevention of uncharacteristic fire and riparian protection, both of which are important to many of the species listed above.

This alternative does include the Lakes and Rivers Management area which focuses on providing recreation opportunities along the Lower Salt River, Verde River, and reservoirs on the forest. This are the primary habitat of bald eagles on the forest. While habitat departure is generally not a concern due to the artificial water management already taking place in the area, emphasizing recreation in this way could increase conflicts between users and the birds.

Alternative C Effects

Effects of this alternative are similar to those in alternative B; however, this alternative proposes considerably more protective management areas which are likely to benefit migratory birds and eagles. The overall increase in objectives and standards protecting habitats (especially riparian areas) is likely to benefit most species. However, the increased focus on using prescribed burns as a primary tool for restoring frequent fire systems may reduce the efficiency of preventing uncharacteristic fire.

This alternative does not include the Lakes and Rivers Management area and would presumably be held to the general management standards for all riparian areas. This has the potential to reduce incidents between recreationists and eagles; however, the same level of protection once there is a conflict would be enforced (usually in the form of a closure order).

Alternative D Effects

This alternative focuses on providing access and multiple use in general and is somewhat less effective at reducing effects to migratory birds and eagles. Much of the habitat direction contained in the other alternatives still applies. However, there are much fewer acres of protected management areas, and the Lakes and Rivers Management Area is included with similar effects as above. This alternative is likely to move habitats towards desired conditions at a slower pace than the other action alternatives.

Cumulative Effects

Four Forest Restoration Initiative

The Four Forest Restoration Initiative (4FRI) includes 2.4 million acres of Northern Arizona Ponderosa Pine forests and associated ecosystems, approximately 300,000 acres of which are on the Tonto National Forest. The intent of the initiative is to restore the area to healthy resilient forests that support natural fire regimes and reduce the risk of uncharacteristically severe wildfire, and provide quality habitat that supports healthy populations of native plants and animals. This effort is very likely to improve many departed habitats for wildlife, primarily in frequent fire systems. This long-term and large-scale project is likely to restore many structural components considered beneficial to species and work to reduce the risk of uncharacteristically severe fire.

Travel Management

The Travel Management Plan proposes to decommission 1,292 miles of motorized routes on the forest. Eventual decommissioning of these routes would reduce the miles of roads within a three-hundred-foot buffer distance of perennial, intermittent and ephemeral streams, and lakes. It would reduce the miles of roads within riparian areas and the number of crossings of perennial, intermittent and ephemeral streams. It would also reduce motorized route density on the forest to. Reduction in the number of miles of motorized routes is likely to reduce impacts to species sensitive to direct or indirect impacts of roads and motorized travel.

Mining Activities

Mineral prospecting and mining is an activity within and near the forest that has occurred for many years. Mineral prospecting by itself has only small surface disturbing activities but mining economical ore deposits can affect larger areas with tailings ponds, leach pads, power, water and other mining infrastructure. Impacts to surface water quantity and quality and groundwater quality and quantity as well as water dependent resources dependent on them have occurred in the past and may occur in the future. The Resolution Copper Project near Superior is currently being evaluated in an environmental impact statement and an environmental impact statement is also being prepared for expansion of the Pinto Valley Mine near Miami-Globe. These projects have the potential to create surface disturbance and affect water resources. Other mineral exploration activities are occurring on the forest. If economically viable ore deposits are discovered and developed, they also have the potential to affect watershed conditions and water resources on the forest.

Tribal Management Activities

The forest is bordered on the east by the Fort Apache and San Carlos Indian Reservations. Watersheds drain primarily from the forest to the reservations. The San Carlos reservation is developing a plan for reducing fuel loadings on both the reservation and the forest in a collaborative process with the forest. Implementation should reduce fuel loading in the thumb area of the Tonto as well as on portions of the San Carlos Reservation bordering the Tonto. Fuel management efforts also occur on the Fort Apache Reservation. These efforts should benefit and complement fuel reduction efforts on the forest and benefit watershed conditions and help reduce the risk of uncharacteristic fire.

Population Growth

The Phoenix metropolitan area is projected to grow rapidly in the near future. As such, it is likely that the number of visitors to the forest will also increase. The increasing footprint from recreationist and other forest users is likely to have an impact on at-risk species on the forest. Disturbances can take the form of habitat degradation, direct mortality, or behavior disturbance. Simultaneously, resources for managing current and future influxes of visitors are limited, increasingly the likelihood of strain on many species.

Population growth may also impact watershed and water resources as the demand increases over time. This is already a vitally strained resource for many species in a largely arid environment. In the face of a warming climate, the strain on this natural resource is likely to become more intense over time.

Climate Change

In general, most climate modelers agree that the Southwest is trending toward prolonged drought. Future potential ecological effects in the Southwest may include an increase in more intense disturbance events such as wildfires, monsoons, and wind. Changing ecological conditions could provide greater opportunities for invasion by nonnative species and disease with the potential to negatively impact various taxa. General trends toward increased moisture deficit could limit overall forest productivity and associated changes in vegetation patterns could affect overall distribution and range of plant and animal species. Cumulatively these factors would likely impact biodiversity, however to what extent is currently uncertain. (Periman 2008, Periman et al. 2009 and references therein).

Invasive Species

A species is considered invasive if it is 1) nonnative to the ecosystem under consideration and 2) its introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112). Invasive species include, but are not limited to, plants, animals, fungi, bacteria, and viruses. Other terms used to describe invasive species are invaders, nonnatives, exotics, pest, and nuisance species. These terms are used interchangeably.

On the Tonto National Forest invasive species have caused massive disruptions in ecosystem function, reducing biodiversity, and degrading ecosystem health in many areas. Invasive species are frequently adapted to a wide range of climates and tend to thrive as early colonizers after disturbances. Changing conditions due to climate change and increased human impacts on many systems may favor the spread and establishment of invasive species. Historically, the Tonto National Forest has suffered from introduced, nonnative species that have threatened native communities through direct competition and predation, or by altering the frequency, severity, or other characteristics of fire regimes and other ecosystem functions.

Riparian and aquatic communities have been especially impacted over time, and many other ecosystems and native species remain at risk of further invasion of harmful nonnative species. Invasive aquatic and wetland organisms are nonnative organisms that have been introduced by humans to an area either deliberately or accidentally, and reproduced so aggressively that native aquatic and wetland species and ecosystems are being negatively affected. In some cases, these organisms may even harm the health of humans.

Five categories can be used interchangeably to describe invasive species: (1) exotic, (2) invasive, (3) competitive, (4) persistent, and (5) aggressive. Throughout the Tonto National Forest, invasive species, along with common weeds, infest native plant communities in increasing numbers. While eradicating weeds is not always possible or needed, aggressive control of existing populations may be important to ensure that native ecosystems are protected.

Plant invasions (such as invasive grasses) have two interrelated components: the first being biological, and the second being environmental. Biological-invasiveness is the capacity of a plant species to spread beyond the site of introduction and establish new sites. Environmental invasiveness is the susceptibility of a habitat to the colonization and establishment of individuals from species not currently part of the local community. For example: many invasive and exotic grasses on the Tonto National Forest, within the Sonoran desert, (e.g., fountain grass and buffelgrass) are highly aggressive, fire adapted, and readily out-compete native plants. Additionally, after burning, these invasive grasses rapidly reestablish.

Affected Environment

Executive Order 13112 defines an invasive species as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." The Forest Service relies on Executive Order 13112 to provide the basis for labeling certain organisms as invasive. Based on this definition, the labeling of a species as "invasive" requires closely examining both the origin and effects of the species. The key is that the species must (1) cause, or be likely to cause, harm and (2) be exotic to the ecosystem it has infested before it can be considered for the "invasive" label.

Invasive biological organisms (i.e., plants and animals) do cause ecological or economic harm to forest resources. While current management emphasis is to manage invasive species, the 1985 plan does not provide direction related to the issue of invasive species. To address invasive plants, managers have implemented an integrated forest wide invasive weed management program. Even though complete eradication of invasive species is not always possible, aggressive treatment of existing populations and prevention of new infestations or populations is important to protect native ecosystems. Management of invasive species is needed across all vegetation types on the Tonto National Forest.

Invasive Plants

The Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants Tonto National Forest: Gila, Maricopa, Pinal, and Yavapai Counties, Arizona (USDA Forest Service 2012b), provides the Tonto National Forest with multiple options to treat invasive plant species. There is an array of tools (e.g., chemical, biological, mechanical, cultural) to help managers control, suppress, or eradicate these species. Identified plant invasive species are treated in the most efficient manner possible with the goal to contain, control, and eradicate each population. There are guidelines for authorized uses of different treatment methodologies, specific mitigation measures for special areas, and general best management practices.

Threats to ecosystems from invasive plant species are generally more severe among low- to mid-elevation sites on the Tonto National Forest. Out of the known invasive species on the Tonto National Forest, invasive grasses are the most abundant and widespread. Cool-season, annual brome grasses pose significant threats to the Arizona-upland subdivision of the Sonoran Desert by increasing the size and number of fires and displacing native species not adapted to fire (D’Antonio and Vitousek 1992). Other exotic grasses, such as fountain grass and buffelgrass, are fire adapted and when growing in an ecosystem not adapted to fire, such as the Sonoran Desert, are capable of disrupting fire regimes and displacing native grass species. In systems where fire is part of the ecology (desert grasslands and chaparral), fountain grass is less of an ecological threat.

Invasive forb species (for example, knapweed and thistles) represent a fairly small proportion of inventoried weeds; they are mainly found on recently disturbed soils along roads and highways. They have the potential to displace native species and increase soil erosion, especially among sites once occupied by native sod-forming bunch grasses. Additionally, many invasive forbs (Dalmatian toadflax, Scotch and bull thistles) are not typically used by native wildlife. The forest has an inventory for weeds, and conducts surveys each year that are documented in the national Natural Resources Information System database. Inventories are concentrated on various areas of the forest including but not limited to major travel corridors, campgrounds, projects on grazing allotments, areas that have burned, etc. Table 197 lists plant species that are invasive on the Tonto National Forest which cause serious issues and their location, and table 198 lists the locations of known populations of nonnative invasive weed species of concern on the Tonto National Forest.

Table 197 and table 198 use the Arizona Wildlands Invasive Plant Working Group ranking of high, medium, and low based on ecological impacts (fire occurrence, erosion, hydrological regimes, nutrient cycling), invasiveness (role of human and natural disturbance in establishment), ecological distribution (the extent of invasion for a given ecological type) and current ecological amplitude (the number of ecological types invaded).

In addition, the Tonto National Forest categorizes invasive plant species as class A, B, or C weeds:

- **Class A weeds** are limited in distribution in Arizona, and the management *goal is eradication*.
- **Class B weeds** are of limited distribution in Arizona, and the management *goal is to contain spread and eliminate populations*.
- **Class C weeds** have spread beyond the capability to eradicate; the management *goal is to reduce population sizes if possible*.

Funding to address invasive plants has been low and is not expected to increase in the near future, despite invasive species being one of the four major threats to National Grasslands and Forests recognized nationally by the Forest Service. The Forest depends upon special funding sources and grants to accomplish a majority of weed control projects. Volunteers are an important part of the Tonto National Forest's invasive plant control program as well. The Tonto National Forest has not been systematically surveyed for invasive species; therefore, many invasive weed populations may be undiscovered, unmanaged and untreated.

Table 197.Known populations of nonnative invasive weed species of concern, Tonto National Forest categories, and Arizona Wildlands Invasive Plant Working Group ranking

Common Name	Scientific Name	Acres	Ranking*	Tonto Categories**	Nonnative Invasive Weed Species Distribution
Asian mustard	*Brassica tournefortii*	3,000	Moderate	C	It progresses in waves following extremely wet years. Biomass accumulates at roadsides increasing the likelihood of wildfire in adjacent deserts.
Buffelgrass	*Pennisetum ciliare*	6,000	High	B	This species has limited distribution; it is mostly restricted to roadsides. Buffelgrass increases the likelihood of fire, and often burns with unexpectedly high intensity.
Bull thistle	*Cirsium vulgare*	20,000	Low	C	This species has limited distribution; it is primarily found at higher moist sites. Bull thistle does not compete well with established native vegetation. It requires disturbance for seeds to land and germinate
Canada thistle	*Cirsium arvense*	8	Moderate	A	This species has limited distribution; it is found near Canyon Creek in the Pleasant Valley Ranger District. Canada thistle competes with native vegetation and depletes soil nutrients and moisture.
Dalmatian toadflax	*Linaria dalmatica*	35	Moderate.	A	The distribution is limited; it is found near the Payson Ranger District.
Diffuse knapweed	*Centaurea diffusa*	250	Moderate	B	This species has limited distribution; there are small infestations in the Pleasant Valley Ranger District. Impacts of diffuse knapweed are increased soil erosion
Fountain grass	*Pennisetum setaceum*	7,000	High	B	This species is widespread on the Tonto; it is found on all ranger districts. Fountain grass increases fuel loads which increases intensity and spread of fires.
Jointed goatgrass	*Aegilops cylindrical*	10	Low	B	This species has limited distribution; recent populations were discovered along Highway 87. If established, jointed goatgrass may produce sufficient litter to carry surface fires.
Malta starthistle	*Centaurea melitensis*	65,000	Moderate	C	This species is widespread at low elevations. Malta starthistle increases soil moisture loss and erosion.
Scotch thistle	*Onopordum acanthium*	50	Low	B	This species has limited distribution; it is found at mid to high elevations, riparian
Red brome	Bromus rubens	150,000	High	C	This species is widespread at low to mid elevations. Red brome alters fire frequency, intensity, and spread. It depletes soil moisture and nutrients.
Sweet resinbush	*Euryops subcarnosus*	27	High	A	This species has limited distribution; it is found in the Tonto Basin. Sweet resinbush increases soil erosion. There are few localized populations with active control efforts.
Yellow starthistle	*Centaurea solstitialis*	8,000	High	B	This species has limited distribution, mainly at higher elevations. Yellow starthistle increases in soil moisture loss and erosion.
Weeping lovegrass	*Eragrostis curvula*	50,000	NA	C	Widespread due to past practices of including them in revegetation seed mixes. Current strategy is to not introduce additional infestations by requiring all seed mixes used on the Forest, to be checked for presence of *Eragrostis* seeds.

Common Name	Scientific Name	Acres	Ranking*	Tonto Categories**	Nonnative Invasive Weed Species Distribution
Lehmann's lovegrass	*Eragrostis Lehmanniana*	20,000	NA	C	Widespread due to past practices of including them in revegetation seed mixes. Current strategy is to not introduce additional infestations by requiring all seed mixes used on the Forest, to be checked for presence of *Eragrostis* seeds.
Karoo bush	*Pentzia incana*	5	NA	A	One karoo bush infestation on the Forest is limited to one disturbed area north of Oak Flat. The other is in association with sweet resinbush near Miami.
Jerusalem thorn	*Parkinsonia aculeata*	30	NA	A	Jerusalem thorn appears to be well-adapted to fire, as a one or two-tree planting grew quickly to a few acres after the Cave Creek Complex Fire burned through a recreation residence where a single tree had been planted. As the plant usually grows in the Sonoran desert,
Globe chamomile	*Oncosiphon piluliferum*	Unknown	NA	B	N/A
Tree of heaven	*Ailanthus altissima*	1000	NA	B	It is a popular ornamental plant in communities within the Forest boundary, such as Globe/Miami, Superior, and Payson. Residents are unlikely to kill or remove these trees that provide shade for their houses and yards.
Giant reed	*Arundo donax*	100	NA	B	There are many established populations of this plant on the Tonto National Forest. *Arundo* is not an extremely aggressive invader. It is possible that after a scouring flood that removes large amounts of *Phragmites* spp. from along the Verde River, *Arundo* may become established in its place. These species occupy similar niches in riparian communities; however, *Arundo* can live on drier sites.
Russian olive	*Elaeagnus angustifolia*	5	NA	A	N/A
Wild oats	*Avena fatua*	20,000	NA	C	Wild oats are extremely widespread on the Tonto National Forest and neighboring forests.
Yellow and Caucasian (Old World) bluestems	*Bothriochloa ischaemu, Bothriochloa bladhii*	Unknown	NA	NA	Yellow and Caucasian bluestems are introduced bunchgrass species that are becoming invasive in southwestern States, it is still being reviewed and monitored on the Tonto National Forest

NOTE: If information on ranking or category is not available for an individual invasive species, then "not applicable" is indicated with NA in the table cell.

* The Arizona Wildlands Invasive Plant Working Group ranking (high, medium, low) is evaluated based on ecological impacts (fire occurrence, erosion, hydrological regimes, nutrient cycling), invasiveness (role of human and natural disturbance in establishment), ecological distribution (the extent of invasion for a given ecological type) and current ecological amplitude (the number of ecological types invaded).

**The Tonto National Forest categorizes invasive plant species as class A, B, or C weeds. Class A weeds are limited in distribution in Arizona, and the management goal is eradication. Class B weeds are of limited distribution in Arizona, and the management goal is to contain spread and eliminate populations. Class C weeds have spread beyond the capability to eradicate; the management goal is to reduce population sizes if possible.

Table 198.The locations invasive weed species of concern on the Tonto National Forest

Scientific Name	Common Name	Tonto Categories**	Rating*	Locations and Issues on the Tonto National Forest.
Acroptilon repens	Russian knapweed	A	High	There are infestations along the Upper Verde River upstream from the Tonto. On the Tonto, very small populations have been documented in the vicinity of Gordon Canyon on Highway 260, and at Shumway Mill site on the Payson Ranger District south of Payson.
Ailanthus altissima	Tree of heaven	C	NA	On the Tonto, it has been documented on the Verde River near Childs, in the towns of Superior and Globe and on National Forest lands nearby. In the spring of 2005, a few pole-sized plants were documented near the confluence of Pinal Creek and the Salt River. Seed were probably carried down the creek from the town of Globe, where the tree grows in abundance. It has also been documented growing in the town of Payson near the Forest boundary.
Arundo donax	Giant reed	B	High	Arundo grows along the Verde River and Lower Salt River and has increased in density invading habitat along banks. With the presence of arundo on the Verde River and Lower Salt River, if a large river flow were to scour the river channel and floodplains, they could be opened up to further invasion by arundo.
Avena fatua	Wild oats	C	Medium	It is found along most highways on the Tonto. It dries out by late spring, providing a source of dry standing fuel to carry desert fires from the highway into adjacent uplands.
Brassica nigra	Black mustard	B	NA	On the Tonto it has been identified growing along Highway 188 through Tonto Basin, and in revegetation sites along Highway 87. It was apparently also a contaminant in seed used for revegetation of safety zones created during suppression of the Willow Fire in 2004; inspections in 2005 found black mustard plants in nearly every safety zone that was seeded.
Cenchrus echinatus	Southern sandbur	A	NA	Sandbur grows along the right-of-way of Highway 60 east of the Tonto National Forest, on the Fort Apache Reservation. It has also been identified on the Tonto, on the right-of-way of Highway 188 a few miles north of Globe
Chondrilla juncea	Yellow starthistle	C	High	On the Tonto National Forest, this plant currently grows mainly on the higher elevation Districts – Payson and Pleasant Valley. Infestations have also been documented in Tonto Basin at elevations below 3000 feet
Isatis tinctoria	Sweet resinbush	A	High	Small (less than 1 acre in size) patches of sweet resinbush, remnants of Civilian Conservation Corps erosion-control plantings, have been mapped south of the Globe Ranger Station, in the same area as the Dimorphotheca population. One infestation of about 3 acres remains in Tonto Basin west of Highway 188; the largest population on the Tonto is approximately 30 acres on the north side of Highway 60, north of the Miami cemetery. It also grows east of the cemetery on slopes and two miles down Bloody Tanks Wash toward Miami. All of these populations are associated with Civilian Conservation Corps civil works projects of the 1930's. Many of the check dams constructed by the Civilian Conservation Corps are still functioning, including some very impressive ones in Bloody Tanks Wash west of Globe/Miami.
Linaria dalmatica	Oxeye daisy	A	Low	It was identified growing inside an elk exclosure along Canyon Creek, on the Pleasant Valley Ranger District. The exclosure fence was recently constructed by the Arizona Game and Fish Department to control overgrazing by elk in this popular fishing area.

Scientific Name	Common Name	Tonto Categories**	Rating*	Locations and Issues on the Tonto National Forest.
Oncosiphon piluliferum	Yellow sweetclover	C	Medium	On the Tonto, it has been used in seed mixes, and has lingered on in wetter sites. It is very common in the riparian zone along the Verde River, on the Cave Creek Ranger District.
Nerium oleander	Oleander	B	NA	There are two sites where it has naturalized on the Tonto National Forest. Several clumps of it have attained great height, growing in Arnett and Telegraph Canyons, near Boyce Thompson Arboretum. Another large individual plant was found growing in Camp Creek, on the Cave Creek Ranger District, apparently naturalized from a nearby recreational residence. One young bush has been identified on the Lower Salt River
Onopordum acanthium	Globe chamomile	B	NA	Isolated patches of globe chamomile have also recently been identified near Skunk Tank Ridge south of Cave Creek on the Cave Creek Ranger District, at the Cave Creek Ranger Station, at the Sonora Desert National Monument, at Pinal City near Superior, along Highway 84 west of Casa Grande, at the Extension Service demonstration garden on east Broadway in Phoenix, on a disturbed site four miles east of I-17 on Carefree Highway, and growing in cultivation at the Desert Botanical Garden and Boyce Thompson Arboretum.
Peganum harmala	Scotch thistle	B	Low	In 2004, the first infestation of this plant was documented on the Tonto, growing in Strawberry at the Highway 87 bridge.
Pennisetum ciliare	Mexican palo verde; Jerusalem thorn	NA	NA	On the Tonto it commonly invades waste areas at low elevations. A single ornamental planting in the Camp Creek area rapidly expanded after burning in the Cave Creek Complex Fire, and now covers nearly 2 acres, after only 4 years. This palo verde has been known to hybridize with palo verde native to Central Arizona
Salvia aethiopis	Russian thistle	C	NA	It is found on the Tonto on recently disturbed soils along roads and highways, and at mining and mill sites. Experienced natural resource managers at the Arizona Department of Transportation state they have not seen this plant spread beyond the immediate area of disturbance, where it phases out under competition when native perennial grasses and other native plants recover
Tamarix chinensis	Wild mustard	B	NA	There are a few small infestations of this mustard growing along Highway 188, from Punkin Center to Roosevelt, on private lands. It is very common on the Agua Fria National Monument, west of Cave Creek Ranger District's Perry Mesa tobosa grassland. The combination of drought, fires, and grazing may have allowed the infestation on the Monument to increase in recent years
Tamarix ssp.	Five-stamen tamarisk	C	High	On the Tonto, salt cedar grows sparsely in many small drainages and along the Verde River and its tributaries. It grows densely along much of the Salt River both above and below the chain of lakes. Salt and Verde River reservoirs have created habitat for salt cedar at inflows into the reservoirs, where there are deep silt deposits and water levels fluctuate too much for native riparian trees such as cottonwood and willow to survive.

NOTE: If information on ranking or category is not available for an individual invasive species, then "not applicable" is indicated with NA in the table cell.

* The Arizona Wildlands Invasive Plant Working Group ranking (high, medium, low) is evaluated based on ecological impacts (fire occurrence, erosion, hydrological regimes, nutrient cycling), invasiveness (role of human and natural disturbance in establishment), ecological distribution (the extent of invasion for a given ecological type) and current ecological amplitude (the number of ecological types invaded).

**The Tonto National Forest categorizes invasive plant species as class A, B, or C weeds. Class A weeds are limited in distribution in Arizona, and the management goal is eradication. Class B weeds are of limited distribution in Arizona, and the management goal is to contain spread and eliminate populations. Class C weeds have spread beyond the capability to eradicate; the management goal is to reduce population sizes if possible.

Invasive Aquatics

When a new aquatic invasive species invasion occurs in a locality, it generally requires research and observation time before reliable inferences can be made regarding spread patterns, specific effects, and potential containment strategies. Thousands of interconnected components and processes make up local environments; therefore, results of eradication efforts in one area can differ from previously disturbed areas. If an aquatic invasive species becomes established, eradication may be nearly impossible and containment efforts can be difficult, time-consuming, and expensive. As a result, land management and natural resource management must prevent invasions whenever possible. Identifying the vectors causing infection and spread and putting safeguards in place to minimize and prevent transmission through these pathways is essential to keep invasive organisms from spreading (USDA Forest Service 2021).

The most vulnerable species are those tied to aquatic systems, including riparian habitats. For example, on the Tonto National Forest American bullfrog and crawfish impact all native fish, amphibian, reptile, macroinvertebrate, and plant species in those systems.

Table 199. Aquatic undesirable and invasive species issues and potential issues to the Tonto National Forest

Scientific Name	Common Name	Issues and potential issues of concern
Dreissena bugensis	Quagga mussel	A quagga invasion alters the aquatic environment in ways that have direct impacts on wildlife and water uses. Invasive mussels consume large amounts of phytoplankton, disrupting the ecological balance of entire bodies of water and eventually impacting and altering both native and sport fisheries. Invasive mussels attach to hard surfaces, creating a hostile environment, which can cause ecological imbalances (Arizona Department of Agriculture 2011).
Orconectus rusticus and *Cherax quadricarinatus*	Crawfish	Crawfish have had an immense adverse impact on the ecosystems they were introduced into decreasing overall biodiversity of fish, amphibians, and macroinvertebrates. Crayfish have spread rapidly through the state and the introduction of additional crayfish species is of great concern.
Lithobates catesbeianus	American bullfrog	Bullfrogs compete with and often times prey upon many aquatic species and have detrimental effects on native fish and amphibian populations. Bullfrogs often have detrimental effects on protected native species, such as the Chiricahua leopard frog and Mexican garter snake.
Pomacea canaliculata	Channeled apple snail	Apple snails have the potential to impact the fish community in the Lower Salt River by outcompeting native snails. Apple snail populations have exploded along the Lower Salt River due to their extraordinary reproduction capabilities (one snail can produce 15,000 offspring in a year) and a complete lack of predators. Large wads of "bubblegum-pinkish" egg masses litter the banks of the river between the Phon D Sutton and Granite Reef recreation sites. These egg masses stain the reeds and banks. These snails displace native species, alter wetland ecosystems, and can act as an intermediate host for meningitis-bearing rat lungworm. This species is considered a nuisance that needs to be removed (Arizona Game and Fish Department 2018).
Potamopyrgus antipodarum	New Zealand mud snail	Three categories of effects can be attributed to the New Zealand mud snail: competition with aquatic grazers (primary consumers); biomass/nutrient sequestration; and reduction in growth of higher-level consumers (predators-fishes) in aquatic systems. The high number of mud snails and their virtual immunity to natural controls may allow them to outcompete native gastropods and exclude other aquatic organisms by their high density (Arizona Department of Agriculture 2011).

Insects and Disease

Insects and pathogens are natural disturbance agents; however, they can also function as stressors when the resiliency of a system is compromised (for example, high stand density, prolonged drought), allowing pathogens and insect outbreaks to reach lethal levels. Under natural conditions, activity by these agents should always be expected, though extent and severity of damage will vary. Overall, insect activity has increased on the Tonto National Forest since the late 1990s, and the acreage affected in the ponderosa pine forest and pinyon-juniper woodlands is much greater than during any earlier period in the historic record. We should not expect trends over the next 10 or 20 years to be similar to the 1970s and 1980s with regards to insect activity and ecosystem processes. The co-occurrence of high vegetation densities, drought, and a warming climate have increased forest vulnerability to herbivorous insects, especially bark beetles. There is potential for catastrophic insect outbreaks to continue in the pine and mixed-conifer forests, but it is difficult to characterize the risks in a temporal framework of 10 to 20 years. There is more uncertainty regarding future insect outbreaks than the past record indicates. The Tonto National Forest is in a period of significant climatic and ecological change, and should expect additional large-scale insect disturbances, though the details of those events cannot be predicted.

Environmental Effects[19]

Stressors and Key Effects of Invasive Species

Effects to Native Species and Habitat

Environmental harm is defined as decreasing native species populations, altering ecosystems of plants and animals, or affecting the ecological processes essential for the survival of both native species and other valuable species. As a result of invasive species, native species populations may see significant decreases, whether due to direct or indirect means. Native species are directly affected by predation, vector diseases, prevention of reproduction, mortality of young, or competition for food, nutrients, light, nest sites, or other vital resources. Reduced populations of rare or endangered species and decreasing populations of other rare or uncommon species are examples of environmental harm. Native species might also be harmed if their numbers drop (Invasive Species Advisory Committee 2007). Significant effects on the environment are often caused by ecological changes across entire regions. This results in conditions that native species and entire plant and animal communities can no longer tolerate. For example, some nonnative plants can change the frequency and intensity of wildfires, or alter the hydrology of rivers, streams, lakes, and wetlands (Invasive Species Advisory Committee 2007).

Effects to Aquatics and Water Bodies

Aquatic invasive species have several detrimental impacts on Arizona's ecosystem, including decreased biodiversity, degraded native vegetation and animal habitat, diminished property values, clogged waterways, negative impacts on irrigation and power generation, and clogged waterways (Arizona Game and Fish Department 2016). Some nonnative plants can alter the hydrology of rivers, streams, lakes, and wetlands. Some invasive aquatic plants can form dense canopies at the water surface that raise surface water temperatures, change pH, exclude light, and consume oxygen, resulting in native plant displacement and stunted fish populations.

Effects to Soil

The invasion of some plants and microorganisms may alter soil chemistry across a large area, changing factors such as soil pH and soil nutrient availability. Plant and animal communities are also impacted by environmental harms, which include changes in composition and structure (Beck et al., 2008). For example, the invasive plant Downy brome (*Bromus tectorum*), also known as cheatgrass, decreases the interval between the occurrences of wildfires from every 70 to 100 years to every 3 to 5 years because it forms dense stands of fine fuel annually. The decrease in interval between wildfires causes increased risk to human life and property and places established communities of plants and animals that we consider desirable at risk.

Effects of Economic Loss and Human Health

Besides economic losses and harm to human and animal health, environmental harm may also cause or be associated with economic losses. The invasion of fire-promoting grasses, for instance, can drastically alter the plant and animal ecosystems, leading to the extinction of or sharp reduction of many native plant and animal species. This can reduce livestock production and increase firefighting costs. As invasive plants displace native and other desirable plant species, they damage the ecology of an area and disrupt local businesses (Beck et al., 2008).

[19] All assumptions and methods used for this analysis can be found in volume 4 of the environmental impact statement, appendix B.

Another example would be the spread of quagga mussels and other aquatic invasive species which can have tremendous financial, ecological, and human health and safety impacts. The highly invasive quagga mussels are very prolific reproducers that can clog water intake structures; greatly increasing maintenance costs for dams, water treatment facilities, irrigation systems, and power plants (Cameron 2020). Recreational activities and family outings on lakes and rivers are adversely affected as invasive mussels aggregate and encrust docks, buoys, boat hulls, engines, and anchors, and create a hazard to human health because of their densely aggregated sharp shells. Left unmanaged, aquatic invasive species have the potential to adversely affect the numbers of recreational boaters and anglers, and the local recreation economy, as well as increase the cost of water delivery to residents and businesses throughout the state.

Effects Common to all Action Alternatives

The effects of treatments depend on the type and extent of treatment. Physical removal (manual and mechanical) results in localized, short-term disturbance. A high rate of disturbance is generally expected in all alternatives.

Burning (wildfire and prescribed) may result in some localized, short-term negative effects; but prescribed burning to manage certain invasive species should result in controllable conditions for fire frequency, duration, and intensity based on environmental conditions at implementation, thus resulting in fairly predictable ecological effects on soils.

Under all alternatives the ecological effects of fire on each fire regime vary enormously according to the time of year; the quantity, condition, and distribution of the fuel; the prevailing climatic conditions; the duration, intensity, and severity of the fire, the slope, aspect, and elevation; and the type of vegetation and soil. Given all the variables associated with fire regimes, the effects from invasive plants can also vary widely from very minimal to very large depending on the magnitude of infestation and overall ecological conditions. The effects on some fire regimes may not be measurable; however, fire suppression may also contribute to the introduction and spread of nonnative plants by creating favorable growing conditions and by transporting seed sources.

Under all alternatives recreation can disturb soils and create conditions favorable to the introduction of invasive species. Recreationists, their vehicles and pets can act as vectors for the dispersal of weed seeds from other areas. Roads and trails can serve as a key indicator for the risk of invasive plant species spread, as vehicles driven through populations of invasive plants often pick up seeds or other plant parts and transport these items to previously uninfected areas. Aquatic-based recreation has the potential to spread aquatic invasive in much the same way as other vehicular use, as well as fishing, boating, walking, and playing in streams and ponds. Recreational activities often include bringing vehicles from various areas together, which transport nonnative species (Anderson et al. 2015).

Under all alternatives growth and development in the Phoenix area and Verde Valley would impact the Tonto National Forest River systems. Potential effects include reduction in streamflow from increased water usage, reduced water quality from increased runoff and sediment input from development in the watershed. The number of forest users would rise, increasing the impacts to riparian areas from increased recreational activities.

Under all alternatives livestock grazing (cows, horses, sheep, etc.) can introduce and spread non-indigenous plants by transporting seeds into uninfested sites, disturbing the soil and preferentially grazing native plants over weed species (Belsky and Gelbard 2000). On areas of the forest where grazing occurs, livestock may continue to contribute to the spread of invasive species. All the activities listed above have at least some potential to spread nonnative invasive plants. All the alternatives include actions that can potentially limit or reduce the spread of nonnative plants. The proposed action would be the most effective in controlling the spread of nonnative invasive plants followed by alternative C.

Under all alternatives, invasive species populations can expand exponentially and cause large losses in ungulate capacity during the life span of this plan. Over time, as weeds spread, tree structure along riparian areas could change from cottonwoods, willows, and other associated species to a near monocultures of invasive species.

Under all alternatives, grazing contributes to invasive plant infestation and spread, because grazing and trampling:

1. remove native plants, clearing vegetation,
2. destroy soil crust and prepare weed seedbeds through hoof action by establishing openings and uncovering soil, and
3. transport and disperse seeds from one area to another.

Alternative A Effects

All invasive species on the Tonto National Forest have the potential to increase beyond any reasonable efforts to control them. These species can have negative impacts on the overall forest landscape, economics, and health and human safety. The 1985 plan (alternative A) does not address invasive species, although law, regulations, and policy guides current management to contain, control, and eradicate them. Current conditions would continue to be maintained, however the direction towards desired condition will be at a slower rate in alternative A, than in other alternatives. The current rate of spread of existing invasive species and the current rate of introduction of new invasive species would continue. The same can be said about other invasive species that are non-plants. With this alternative, there would be no alteration to current methods and types of treatments that are currently used on the Tonto National Forest. The established best management practices that are implemented for every ground-disturbing project (USDA Forest Service 2005) have been effective to date in reducing existing known populations, allowing for the survey for new infestations in areas expected to receive future treatment, and measures to be taken that can reduce the vectors for invasive species introduction.

While creating temporary disturbances, forest management actions in the resource areas of ecosystems, range, recreation, forestry, etc., also provide for long-term benefits that can limit future invasive species infestations. When known and unknown areas go untreated, they can be more susceptible to high-severity wildfires that can greatly alter the ecosystems and create the highest potential for new invasive species infestations.

Depending on the type of species (plant, animal, or insect), the presence of invasive species in the Tonto National Forest can negatively affect public recreation opportunities and native ecosystems. Currently the Tonto National Forest uses the Environmental Assessment for Integrated Treatment of Noxious and Invasive Plants (2012b) document for managing existing invasive species on the forest. Sustainable recreation practices are not incorporated in the alternative, therefore major pathways for the movement of invasive species are a huge issue, and with the continued growth of recreation, the movement and establishment of invasive species will increase.

This alternative would not include any additions to wilderness areas. All current non-wilderness areas would continue to have same potential for new infestations and the same authorized methodologies for treatment and control. This alternative provides for the highest rate of access to the highest portion of acres on the forest by not establishing new wilderness areas or making additions to existing wilderness areas. By continuing management under the existing forest plan, all of the existing options for invasive species survey and treatment would continue. While there are restrictions in treating invasive species in the areas proposed for wilderness in the other alternatives, invasive species treatment by current approved forest methodologies would remain an option if an infestation was detected.

Alternative B Effects

Alternative B proposes vegetation management in frequent-fire ecosystems (ecological response units) and focuses on restoring fire as a key ecosystem process. This will be accomplished through a balance of mechanical treatments and wildland fire. Also, under this alternative are objectives to restore grass and herbaceous cover for highly departed ecological response units (pinyon juniper grass and juniper grass) with the emphasis of using fire with some mechanical thinning. Depending on the ecological response unit, a variety of other treatments, such as invasive species treatments and reseeding native species; may be necessary to meet plan objectives.

With increased ground disturbance compared to alternative A, there would be an increased threat of spreading existing infestations. Without early detection and treatment, invasive species like Lehman's love grass and buffelgrass have the ability to emerge, reproduce, and rapidly invade these areas, outcompeting the native species. There would also be an increased threat of new species introduced from vehicles and machinery coming into the plan area to perform restoration activities. Combining best management practices designed to reduce introduction of invasive species by monitoring for species before, during, and post project; and using existing methodologies to control invasive species detected; a healthier ecosystem less prone to invasive species invasion can be achieved.

Objectives established for desert ecosystems in alternative B include actively suppressing fire and focusing restoration primarily on reducing disturbance to sensitive soils and treating invasive species (specifically exotic and invasive grass species). For invasive species in this ecosystem:

- Survey, inventory, or treat 10,000 to 15,000 acres of invasive species (e.g., buffelgrass, fountain grass, and red brome) in desert ecological response units (Sonoran Desert plant communities and Sonora-Mojave mixed-salt desert scrub) over a 10-year period.

In the long term this will be highly effective for desert ecosystems especially when combating buffelgrass and fountain grass. This alternative also highlights the health and function of riparian areas, often prioritizing them over other uses including recreation, grazing, and mining. Activities such as recreation, grazing, and mining can involve ground disturbing actions which promote the spread and growth of invasive species. In the long term this alternative provides the best strategy for the control, treatment and management for invasive species in riparian areas due to its prioritization of riparian areas as an ecosystem component with respects to health and function.

Alternative B emphasizes sustainable recreation opportunities, which are managed to balance public demand and natural resource desired conditions and aimed at “right sizing” opportunities on the forest. There is also an assumption that there is potential for new roads and trails (motorized and nonmotorized). Roads and trails can serve as a key indicator for the risk of invasive plant species spread. Vehicles driven through populations of invasive plants often pick up seeds or other plant parts and transport these items to previously uninfected areas. Aquatic-based recreation has the potential to spread aquatic invasive species in much the same way as other vehicular use, as well as fishing, boating, walking, and playing in streams and ponds. As mentioned above, outdoor recreation often involves the frequent congregation of people, vehicles, and vessels from geographically diverse areas, which transport nonnative species. Common recreational activities (such as hiking, mountain biking and off-road driving) can act as forms of habitat disturbance, potentially facilitating species invasion. Disturbance occurs when an activity interferes with the natural habitat in an area, changing niche opportunities for the species within the habitat. Nonnative species are often particularly successful in disturbed habitats as their superior rates of growth and reproduction enable them to quickly colonize disturbed areas. Using best management practices for invasive species under alternative B, road decommissioning objectives can move the invasive species program towards the desired condition “Recreation on the forest is sustainable and responds to changes in science, technology, and best management practices when implementing new projects and updating or upgrading existing infrastructure” (REC-DC-03) and the objective “Every 5 years take appropriate action (e.g., close, decommission, or convert) on at least 10 miles of motorized and/or nonmotorized trails[20] that may not offer recreational value (e.g., unsustainable, low-use, or have no remarkable destination value) or are not needed for administrative use” (REC-O-05).

Approximately 43,204 acres are analyzed as recommended wilderness for alternative B. The Tonto National Forest has an invasive species inventory system. However, much of the forest has not been intensively surveyed for weeds and other invasive species. If infestations are within these recommended wilderness areas, the ability to use integrated pest management tactics available to the Forest (such as chemical, cultural, and mechanical treatments) would be limited unlike in alternative A. In addition, this could limit cost-effective options to treat weeds and other invasive species in these areas when infestations are found.

Alternative C Effects

This alternative would have similar consequences with regards to invasive species as alternative B. Vegetation management in frequent-fire ecosystems/ecological response units would rely on fire as the primary restoration tool. Mechanical thinning would only be used in limited situations (e.g., wildland-urban interface areas or invasive species treatments).

Alternative C proposed the least amount of mechanical thinning. Therefore, alternative C would have the least potential for negative effects that come with mechanical thinning operations which include increased ground disturbance capable of increasing the spread of invasive species. Without early detection and strategy, invasive species like Lehman's love grass, buffelgrass or red brome have the ability to emerge, reproduce, and rapidly invade these areas, outcompeting the native species. There would also be a decreased threat of new species introductions from vehicles and machinery used in restoration activities, due to mechanical restrictions. With this alternative, a healthier ecosystem less prone to invasive species invasion can be achieved by combining best management practices that reduce the introduction of invasive species by; monitoring for species before, during, and post-project; and continuing to control invasive species when detected.

Objectives to restore grass and herbaceous cover for highly departed ecological response units (pinyon juniper grass and juniper grass) are similar to alternative B; however, mechanical thinning would only be used in limited situations (e.g., wildland-urban interface areas or invasive species treatments). Using the mechanical option as a tool for integrated pest management could still prove to be effective as managers still have the ability to use all allowable tools and resources to manage invasive species under this alternative. Objectives for desert ecosystems are the same as alternative B. Fire is actively suppressed, and restoration is primarily focused on reducing disturbance to sensitive soils and treating invasive species (specifically exotic and invasive grass species). In the long term this will be highly effective for desert ecosystems especially when combating buffelgrass and fountain grass. This alternative also highlights the restoration of riparian areas and emphasizes the management of invasive species in disturbed or high-risk areas. It limits or restricts other uses that impact these ecosystems, such as grazing,

[20] Designated trails / routes

mining, and recreation, which can involve ground disturbing actions that promote the spread and growth of invasive species. This alternative is optimal for the control, treatment and management for invasive species in riparian areas due to its emphasis on riparian health focusing on the threat and destruction that invasive species cause. As with alternative B, alternative C benefits riparian health and function with respect to invasive species.

In alternative C, the components of recreation are similar to alternative B. However sustainable recreation opportunities are managed to emphasize nonmotorized and primitive recreation. The assumption is there is a potential for less roads and trails (motorized and nonmotorized). Trails and roads can serve as vectors for invasive species, so the potential for less roads and trails in alternative C reduces the threat that invasive species will be spread, unlike alternative B. In the context of recreation, alternative C, using best management practices for invasive species and the road decommissioning objectives set by both areas (invasive species and recreation), can move the invasive species program towards the desired condition: "Recreation on the forest is sustainable and responds to changes in science, technology, and best management practices when implementing new projects and updating or upgrading existing infrastructure" (REC-DC-03) and the objective "Every 5 years take appropriate action (e.g., close, decommission, or convert) on at least 10 miles of motorized and/or nonmotorized trails[21] that may not offer recreational value (e.g., unsustainable, low-use, or have no remarkable destination value) or are not needed for administrative use" (REC-DC-O-05).

Approximately 399,029 acres are proposed as recommended wilderness in alternative C. Although the Tonto National Forest has an invasive species inventory system, much of the forest has not been intensively surveyed for weeds and other invasive species, including within these recommended wilderness areas. If infestations are within these areas, the ability to use integrated pest management tactics available to the forest (such as chemical, cultural, and mechanical treatments) would be limited unlike in alternative A. In addition, this could limit cost-effective options to treat weeds, and use other invasive species treatments in these areas when infestations are found.

Alternative D Effects

Alternative D focuses on reducing restrictions on land uses, and includes no additional recommended wilderness acres, which makes the effects of alternative D very similar to the effects of alternative A.

Objectives to restore grass and herbaceous cover for highly departed ecological response units (pinyon juniper grass and juniper grass) are similar to alternative B, however there are fewer treatment objective acres (more treatment objective acres are allocated to forested ecological response units). Depending on the ecological response unit, a variety of other treatments such as treating invasive species and reseeding native species may be necessary to meet plan objectives.

Alternative D would have the highest potential of negative effects that come with mechanical thinning operations, including increased ground disturbance which could increase the spread of invasive species. Without early detection and treatment, invasive species like Lehman's love grass, buffelgrass, and red brome have the ability to emerge, reproduce, and rapidly invade these areas, outcompeting the native species. There would also be an increased threat of new species introduced from vehicles and machinery coming into the project area to perform restoration activities. Combining best management practices designed to reduce introduction of invasive species by monitoring for species before, during, and post project; and using existing methodologies to control invasive species detected; a healthier ecosystem less prone to invasive species invasion can be achieved.

[21] Designated trails / routes

Recreation Management

The focus on developed and dispersed recreation opportunities will be more easily accessible to the public in alternative D.

People, vehicles, and vessels that regularly congregate in outdoor recreation areas come from geographically diverse areas, which can transport nonnative species, which will grow increasingly problematic as these sectors continue to grow (Anderson et al. 2015).

Common recreational activities (such as hiking, mountain biking and off-road driving) can act as forms of habitat disturbance, potentially facilitating species invasion. Disturbance occurs when an activity interferes with the natural habitat in an area, changing niche opportunities for the species within the habitat. Nonnative species are often particularly successful in disturbed habitats as their superior rates of growth and reproduction enable quick colonization of disturbed areas.

Roads function as prime habitats and corridors for invasive plant species and can contribute significantly to the spread and establishment of invasive and undesirable species inside protected areas. Roadsides provide well-drained, open habitats that are disturbed by maintenance activities (such as vegetation mowing and drainage ditch cleaning). They can be colonized by a wide array of native plant species, but their characteristics (open and disturbed) are particularly propitious for the establishment of opportunistic invasive and undesirable species. The highly connected nature of road networks facilitates the dispersal of seeds, spores or other reproductive parts, and consequently the spread of invasive species. Some invaders escape from road verges and colonize neighboring natural or man-made habitats. Roads can significantly contribute to the spread and establishment of invasive species inside protected areas. These species may then have serious impacts on the ecological integrity of highly valued natural ecosystems (National Research Council 2005). Therefore, in alternative D, to accommodate increasing use and need for accessibility on the forest, the increase in objectives for road and facility maintenance and development will have the most potential additive risk of invasive plant species than any other alternative (A, B, and C).

Cumulative Effects

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current conditions (as detailed in the description of the affected environment and alternative A) as proxies for the impacts of past and present actions. This is because existing conditions reflect the aggregate impact of all prior actions.

Time Boundary for Analysis

The time frame used for this cumulative analysis is 30 years, which is longer than the approximately 15 years that this forest plan is expected to frame the management of the forest. It is foreseeable that the forest will experience a weakened invasive species footprint and presence within 10 to 30 years by following objectives, standards, guidelines and management approaches in respects to invasive species. Efforts to reach desired condition for the next 30 years can be considered a real possibility. Rationale for the time boundary is as follows:

- Funding levels have been low and are not expected to increase in the near future, despite invasive species being a major threat to the Tonto National Forest.
- The Forest depends upon special funding sources and grants to accomplish large weed control projects. Volunteers are an important part of the Tonto National Forest’s invasive plant control program.

- Control projects of the scale and type conducted by the Tonto National Forest have not been adequate to prevent weed infestations from increasing.
- The Tonto National Forest has not been systematically surveyed for invasive species. Populations of some invasive species have been known for nearly 30 years and have spread considerably, since they were first identified. Others are still being found in small infestations.
- With an increasing population of people that visit the Tonto National Forest, the concern for invasive species will only rise.
- With the issue of climate change invasive species are, by nature, highly flexible, and respond to unusual environments more quickly than do natives. And now, with the help of climate change, the invasive species also reap the benefits that come with early blooming such as shading out competitors and capturing a larger share of nutrients, water or pollinators.
- The possibility of new invasive species entering the landscape is very high.

Spatial Boundary for Analysis

The analysis area for this environmental impact statement is the entire Tonto National Forest.

Reasonably Foreseeable Actions

This analysis focuses on the cumulative impact of those reasonably foreseeable actions that are relevant in assessing the impacts of revising the forest plan. In terms of reasonably foreseeable future actions, this analysis includes the following:

Economics

The introduction of new organisms to the Tonto National Forest will be a constant threat to its environment. This most likely will impact various industries (horticulture, travel, recreation, etc.) which are influenced by the broader landscape. Organisms that arrive and establish themselves in a new range will be positioned to adversely affect the surrounding flora and fauna across all ecosystems on the Tonto National Forest. New, as well as existing (invasive) organisms can become invasive or further spread, which can produce staggering economic and environmental costs. This will be true for both intentional and unintentional introductions. Invasions by species of plants, animals, and microorganisms can cause the displacement and disruption of native species which will and can be of economic concern. The destruction amongst ecosystems via invasive species, such as changes in fire regimes, nutrient cycling, and hydrology will accumulate cost, measuring well pass the millions, for the Forest and its surroundings. Moreover, for every class of invasions, many effects can go undetected or unmeasured, because there are limited resources available to combat damaging invasive species.

Population and Pressure

Phoenix is the fastest-growing city in the country, according to newly released estimates from the US Census Bureau. Phoenix welcomed 25,288 new residents between 2017 and 2018 — more than any other American city. Phoenix remains the fifth-most populous city with a population of 1,660,272.[22] Because this metropolitan area basically borders the Tonto National Forest (with just the separation of a few miles), associated environmental pressures and invasive species vectors will become more of a challenge in the future. This is not a conclusion, but rather a correlation and connection. The *natural* or *man-made* means and routes by which invasive species are introduced into forest ecosystems will only become more challenging as the population of the metropolitan area grows. These consequences will be intentional, which is the result of a deliberate movement of a species by humans outside of its natural range; and

[22] https://www.bizjournals.com/phoenix/

unintentional, which is the inadvertent movement of species as a byproduct of some other human activity. Examples of pathways include but are not limited to agricultural materials, ballast water, firewood, fishing gear, fouled boat hulls, pets (unwanted or escaped), plants and plant parts (escaped or disposals), and recreational vehicles.

Public Sentiment

The Tonto National Forest's main objective regrading invasive plant species is eradication, containment, and/or control of invasive plant species on the Cave Creek, Globe, Mesa, Payson, Pleasant Valley, and Tonto Basin ranger districts. One of the treatment options that the Forest uses is the application of herbicides. However, there is a growing trend of public sentiment which is not in favor of using herbicides to treat invasive species because of environmental and health concerns. It should be noted that federal laws and policies regulate many aspects of herbicides including labeling, registration, and application, but these regulations are not a substitute for a thorough knowledge of the risks associated with herbicide use. The benefits of herbicides must be weighed against the potential for exposure and impacts to human health, non-target organisms, and the environment. Risks are always present with any herbicide use, but improper use or misapplication can increase these risks. In many cases there is no viable option for treatment other than herbicides to gain some means of containment, and control. It is foreseeable that if we do not use chemicals in the future, we will have more limited ability to treat invasive species effectively.

Funding

Funding levels have been low and are not expected to increase in the near future, despite invasive species being nationally recognized by the Forest Service as one of the four major threats to national grasslands and forests. The Forest depends upon special funding sources and grants to accomplish weed control projects. Volunteers are an important part of the Forest's invasive plant control program. It is foreseeable that this will be a continued trend.

Climate Change

With the issue of climate change, invasive species are, by nature, highly flexible, and respond to unusual environments more quickly than do natives. And now, with the help of climate change, invasive species also reap the benefits that come with early blooming such as shading out competitors and capturing a larger share of nutrients, water or pollinators. In addition, land use change and changes in the nitrogen and carbon cycles have been identified as top drivers of global biodiversity loss. Their relative importance depends on the eco-region being considered. Biodiversity loss is accelerating because of many factors, including pollution, globalization of trade, increased tourism, etc. Climate change can facilitate invasive species as new species that may become invasive will be entering regions due to climate change; species hierarchies in ecosystems will change, leading to new dominants that may have invasive tendencies; and climate-induced stress in an ecosystem will facilitate invasive pathways.

Soils

Soils provide many benefits on which other life forms (including humans) depend by providing a substrate and nutrients for plants, through thermoregulation (daytime heat absorption, nighttime heat release), nutrient cycling, and water purification and storage. Soils provide wildlife habitat (burrows, dens), plant-growth media (nurseries), and fill (construction). The diverse and productive soils of the Tonto are described, characterized, and classified in the draft Terrestrial Ecological Unit Inventory of the Tonto National Forest.

Affected Environment

Across the Tonto National Forest, soils vary from an aridic (dry) moisture regime and a hyperthermic (extremely hot) temperature regime at the lower elevations in the Sonoran Desert scrub vegetation to an udic (humid-subhumid) moisture regime and a frigid (cold winter, warm summer) temperature regime in the mixed conifer forests at the highest elevations. On steeper slopes, soils tend to be shallow and skeletal (containing more than 35 percent rock fragments) due to naturally higher rates of erosion and a slower rate of soil development. There is less soil development on the more unstable steeper slopes. Moderately steep to flat slopes tend to have deeper, more developed soils, and rock fragment content can be variable. Soil texture varies by parent material kind and origin. Soils developed in parent material that weathers easily, such as diabase and basalt tend to have a high clay-sized particle content; while soils developed in parent materials that are resistant to weathering, such as granite, metasedimentary rock and tuff have a high sand-sized particle content.

The Tonto National Forest occurs in a geologically diverse area that spans three distinct ecological sections; the Sonoran Desert, Tonto Transition, and White Mountain-San Francisco Peak-Mogollon. For purposes of this report, the Tonto National Forest will be summarized by each of these ecological sections due to similarity in geomorphology and lithology.

Geology

The Sonoran Desert section of the Tonto National Forest is in the Basin and Range physiographic province and the American Semi-Desert and Desert province. This section is located in southwestern Arizona and makes up the southern and lower elevations of the Tonto National Forest. The Range portions of this physiographic section are dominated by structural bedrock, and common landscapes are mountains and hills. The lithology of these areas is dominated by volcanic andesitic and rhyolitic tuff ranging from 11 to 38 million years, granitic rock ranging from 1400 to 1800 million years and to a lesser extent metasedimentary rock ranging from 1600 to 1800 million years in age. The Basin portions of this physiographic section are dominated by fluvial geomorphic processes producing basins, fan piedmonts, and plain landscapes. The lithology of the basin portions of this section are dominated by surficial deposits ranging in age from 0 to 750 thousand years in age from single or multiple sources.

The Tonto Transition section of the Tonto National Forest is located between the Basin and Range and Colorado Plateau physiographic provinces and is part of the Colorado Plateau Semi-Desert province. The Tonto Transition section makes up a majority of the Tonto National Forest, meeting the Sonoran Desert section to the south and the White Mountain-San Francisco Peak-Mogollon Rim section to the north. Precambrian through Mesozoic volcanic activity and sedimentary deposition are major geomorphic processes in this section. Common landscapes in the Tonto Transition section include fan piedmonts, foothills, hills, and mountains. The lithology of the Tonto Transition is complex and, in places, highly dissected. Dominant lithologies include granitic rock ranging from 1400 to 1450 million years, sedimentary rock ranging from 770 to 1300 million years, diabase ranging from 1050 to 1150 million years, basaltic rock ranging from 8 to 16 million years, and alluvial deposits ranging from 2 to 16 million years in age.

The White Mountain-San Francisco Peak-Mogollon Rim section of the Tonto National Forest is in the Colorado Plateau physiographic province and the Arizona-New Mexico Mountains Semi-Desert-Open Woodland-Conifer Forest-Alpine Meadow province. The White Mountain-San Francisco Peak-Mogollon Rim section of the Tonto National Forest makes up the smallest portion of the Tonto and is located in the northwest part. This portion of the White Mountain-San Francisco Peak-Mogollon Rim section located on the Tonto National Forest is a plateau landscape dominated by a sequenced lithology of sedimentary rocks 330 to 540 million years, 280 to 310 million years, and 270 million years in age.

Climate

The climate is highly variable as a consequence of the uneven topography, wide range in elevation and seasonal distribution of precipitation. The elevation ranges from a low of 1,300 feet near Granite Reef Dam on the southwestern end of the Mesa Ranger District to a high of 7,900 feet at Mazatzal Peak located in the central area of the Tonto National Forest on the Cave Creek Ranger District. Climate varies from the hot, dry Sonoran Desert at the lower elevations to the cool, moist montane coniferous forest at the higher elevations.

Plant communities follow a climatic, elevational gradient from low elevation Sonoran desert scrub, to semi-desert grasslands, to pinyon-juniper woodland, to mid-elevation ponderosa pine forest, and to mixed conifer forest. The majority of the Tonto National Forest Sonoran desert scrub, semi-desert grasslands, evergreen oak, pinyon-juniper woodlands, and ponderosa pine forest plant communities are in the mild winter climatic zone. Ponderosa pine and mixed conifer plant communities on the upper portions of the Sierra Anchas Mountains and the Pinal Mountains, and those located within the White Mountain-San Francisco Peak-Mogollon Rim ecological section are in the cold winter climatic zone.

Biological Soil Crusts

An important component that affects soil condition is the condition of biological soil crusts. Biological soil crusts are the community of organisms, including cyanobacteria, green algae, microfungi, mosses, liverworts, and lichens, living at the surface of soils (Belnap et al. 2001). Biological soil crusts are commonly found in and play an important role maintaining the productivity of pinyon juniper woodland, semi-desert grassland, and desert community's ecological response units on the forest. They are found to a limited extent in other vegetation types drier than pinyon juniper woodland. Crusts are well adapted to severe growing conditions, but poorly adapted to compressional disturbances. Domestic livestock and elk grazing, and more recently, recreational activities (hiking, biking, and off-road driving) can degrade the integrity of the crusts. Disturbance can reduce organism diversity, soil nutrients, soil stability, organic matter and soil productivity and increase soil loss. Biological crusts can be destroyed by surface fires.

Soil Condition

Soil condition is an evaluation of soil quality based on factors which affect vital soil functions. Soil quality is the capacity of the soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health (Doran and Parkin 1994). The interrelated functions of soil hydrology, soil stability, and nutrient cycling are evaluated to assess soil condition.

- **Soil hydrology:** This function is assessed by evaluating or observing changes in surface structure, surface pore space, consistence, bulk density, infiltration, or penetration resistance using appropriate methods. Increased bulk density or reduced porosity results in reduced water infiltration, permeability, and plant-available moisture.

- **Soil stability:** Erosion is the detachment, transport, and deposition of soil particles by water, wind, or gravity. Vascular plants, soil biotic crusts, and litter cover are the greatest deterrents to surface soil erosion. Visual evidence of surface erosion may include rills, gullies, pedestalling, soil deposition, erosion pavement, or loss of the “A” (surface) horizon. Erosion models are used to predict on-site soil loss.
- **Nutrient cycling:** This function is assessed by evaluating plant community composition, litter, coarse woody material, root distribution, and soil biotic crusts. These indicators are directly related to soil organic matter, which is essential in sustaining long-term soil productivity. Soil organic matter provides a carbon and energy source for soil microbes and provides nutrients needed for plant growth. Soil organic matter also provides nutrient storage and capacity for cation and anion exchange.

Soil Condition Categories

The soil condition category is an indication of the status of soil functions. Soil condition categories reflect soil disturbances resulting from both planned and unplanned events. Current management activities provide opportunities to maintain or improve soil functions that are critical in sustaining soil productivity. The following is a brief description of each soil condition category:

- **Satisfactory:** Soil function is being sustained, and soil is functioning properly and normally. The ability of soil to maintain resource values and sustain outputs is high.
- **Impaired:** The ability of soil to function properly has been reduced or there is an increased vulnerability to degradation. An impaired rating should signal to land managers a need to further investigate the ecosystem to determine causes and degrees of decline in soil functions. Changes in management practices or other preventative actions may be appropriate.
- **Unsatisfactory:** Loss of soil function has occurred. Degradation of vital soil functions results in the inability of soil to maintain resource values, sustain outputs, and recover from impacts. Soils with an unsatisfactory rating are candidates for improved management practices or restoration designed to recover soil functions.
- **Unsuited:** Areas rated unsuited are those where geologic erosion rates are greater than soil formation rates. Soils are inherently unstable and may occur on steep slopes. These soils are generally associated with badlands and other miscellaneous areas.

Soil condition is ultimately influenced by management. Existing management activities need to be evaluated to determine if the current management activity is contributing to the loss of soil function. In some cases, current management activities may not have caused the loss of soil function but may be preventing recovery. Management activities that slow or prevent recovery of soil function should be avoided. Satisfactory soil condition (soil quality) is important in maintaining long-term soil productivity, which is key to sustaining ecological diversity. Unsatisfactory and impaired soil conditions reduce the ability of the soil to grow plants and sustain productive, diverse vegetation.

Very little quantitative data exist to measure historical soil condition. However, some qualitative and quantitative inferences can be made by using information about existing disturbances and their effect on soil stability, soil compaction, and nutrient cycling. Reference conditions generally estimate pre-European settlement conditions.

Historically (without human disturbance), soil loss, soil compaction, and nutrient cycling would probably have been within functional limits to sustain soil function and maintain soil productivity for most soils that are not inherently unstable, the exception being during cyclic periods of drought and possibly local areas impacted through non-domestic herbivory. Natural flood disturbance would have had a limited effect on the extent of soil loss, only causing accelerated erosion adjacent to stream channels or floodplains. Drought may have reduced the amount of protective vegetative groundcover resulting in accelerated erosion during prolonged rainstorms. Most areas that are currently impaired and unsatisfactory for soil condition would probably have been historically satisfactory for soil condition.

Table 200.Estimated historic versus current soil condition percentages on the Tonto National Forest

Soil Condition Class	Historical Percentage	Current Percentage	Difference between Historical and Current percentage
Satisfactory	88 percent	35 percent	53 percent
Impaired	Low	32 percent	32 percent
Unsatisfactory	Low	16 percent	16 percent
Unsuited	16 percent	16 percent	0 percent

The most productive soils (satisfactory soil condition) historically and currently are in the interior chaparral, mixed conifer-frequent fire, ponderosa pine-evergreen oak, ponderosa pine forest, Fremont cottonwood-conifer, and ponderosa pine/willow ecological response units (figure 1). These ecological response units produce high amounts of biomass and organic matter that maintain soil cover and soil stability, and support nutrient cycling.

The narrowleaf cottonwood/shrub and the Sonoran paloverde-mixed cactus desert scrub ecological response units were historically very productive and assumed to have satisfactory soil condition but are now impaired by reduced soil function. The lack of effective vegetative groundcover and organic matter has resulted in unstable soils with reduced hydrologic function and nutrient cycling in these ecological response units.

The pinyon-juniper grass, Fremont cottonwood/shrub, sycamore-Fremont cottonwood and Sonoran-Mojave creosote-bursage desert scrub ecological response units are all at least 40 percent unsatisfactory (figure 1). In these ecological response units, lack of vegetative groundcover (observed mainly as insufficient litter, basal area, and subsurface roots) may be contributing to decreased hydrologic function and stability.

Some soils are considered unsuited-inherently unstable. Unsuited-inherently unstable soils are those in which their geologic formation and geomorphic properties (for example, steep slopes) are naturally active, and soil erosion has existed historically and will continue. Unsuited-inherently unstable soils are dispersed across the landscape and occur primarily in the juniper grass and Madrean encinal woodland ecological response units. Soil erosion hazard influences soil condition; an inherently unstable soil is more vulnerable to soil condition impairment than an inherently stable soil.

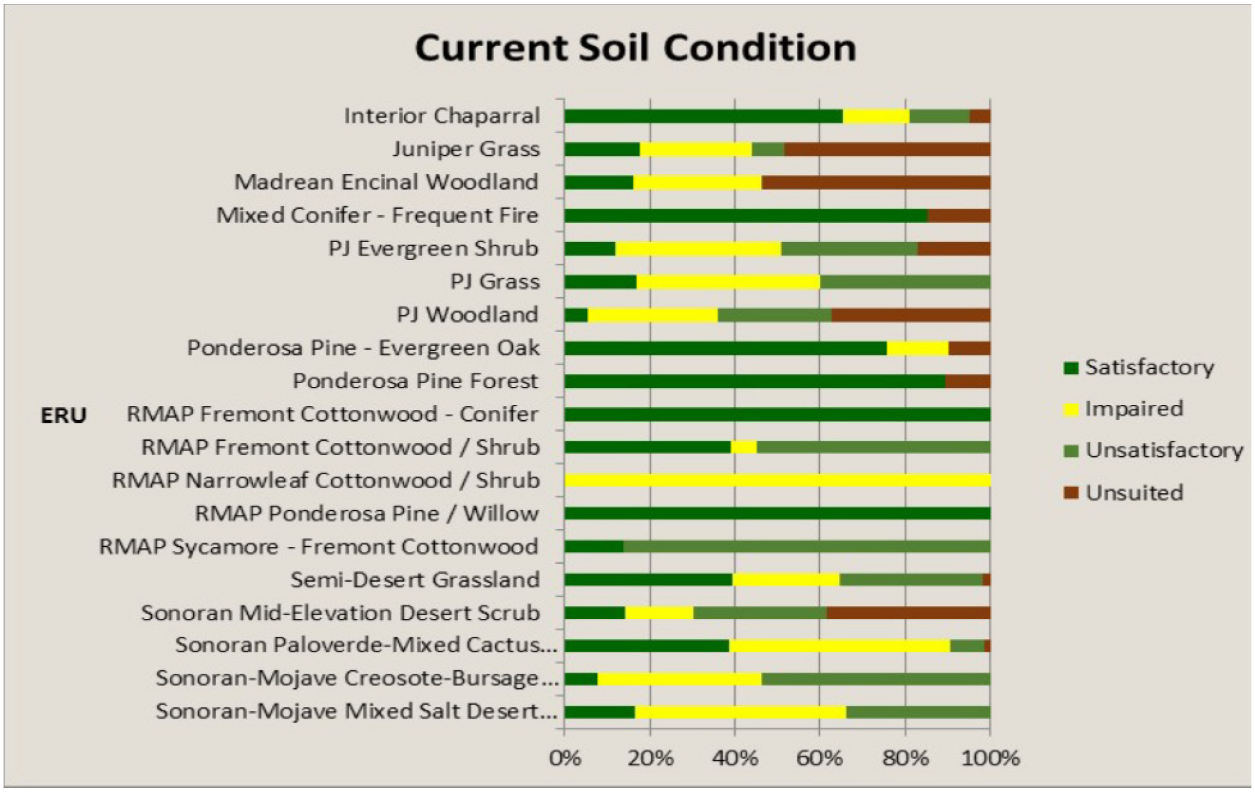

Figure 1. Current soil condition on the Tonto National Forest for the major upland and riparian ecological response units

The data show at least 50 percent impaired and unsatisfactory soils in over half (53 percent) the ecological response units, indicating a need for change in current management, particularly in the pinyon-juniper, Sonoran Desert, and the majority of the riparian ecological response units.

Until unmanaged herbivory is controlled, and the frequency and magnitude of disturbances fall within the historic range of variation (Schussman and Smith 2006), the trend will continue to move away from reference condition, at the same or increased rate. This will affect soil productivity, which will in turn affect forage production and other resources on the Tonto National Forest. As with erosion hazard, soil condition trends are similar on both private and public lands. However, on adjacent National Forest System lands, soil condition is improving to satisfactory due to changes in management. On the Coconino National Forest, for example, current soil condition is 79 percent satisfactory with only 10 percent unsatisfactory, and slightly over 10 percent unsuited-inherently unstable (USDA Forest Service 2007). With a change in current management, some factors of soil condition, like overstory canopy and groundcover, may improve quickly. Other factors take a long time to improve (recovery of lost topsoil) and could impact resources for quite some time.

Environmental Effects[23]

Effects Common to all Alternatives

Livestock grazing

Grazing decreases the amount of standing vegetative cover. It also reduces the amount of continuous plant litter and redistributes organic material by decreasing litter and increasing manure. The manure improves the nutrient status of soils and accelerates nutrient cycling within the ecosystem, but it is not distributed continuously across the landscape like plant litter is in ungrazed or lightly grazed areas. This situation may lead to an increase in the amount and size of patches of exposed soil which can lead to increased soil erosion rates. Grazing can reduce the amount of fine fuel, which can reduce natural fire frequency and intensity (i.e., lower flame length) in grasslands, allowing for establishment of trees and shrubs (Davies et al. 2015).

Grazing animals trample vegetation and damage soil surfaces by pulverizing soil aggregates. They can damage soil biological crusts through compressional disturbance. Although trampling may increase the speed at which organic matter (litter, manure, and woody debris) is incorporated into the soil and expose soil surfaces to improve seed germination and plant establishment, it can also increase soil compaction, decrease aggregate stability, and increase the risk of wind and water erosion, particularly in areas where livestock concentrate. Compaction reduces water infiltration rates, water-holding capacity, and soil aeration, which lead to losses in plant productivity. Compaction may increase runoff rates that contribute to sheet, rill and gully erosion.

Standards and guidelines would protect soil by maintaining a balance of permitted use and range capacity for range allotments by changing the numbers of livestock, changing management intensity levels, and initiating changes in livestock class, rotation patterns, etc. Various management approaches for permitted use and capacity are addressed at the project level, which considers range, riparian, watershed conditions, economic feasibility, implementation practicality, and wildlife habitat among other factors. Various methods for controlling livestock distribution and preventing overuse which could damage soil are analyzed at the project level. These methods include using cattleguards, water-troughs, and salt; controlling livestock grazing through management and/or fencing to establish vegetation and eliminate overuse; and managing seeding projects to avoid concentrating livestock use in riparian and other sensitive areas.

Minerals

Mineral extraction can adversely affect soils through complete removal and mixing or churning of soil horizons, increased bare ground subject to erosion by wind and water, soil compaction, changes to nutrient cycles, and soil contamination. Disruption of soil aggregates can result in changes to particle size distributions and reduced soil stability. Management direction for minerals recognizes that minerals are fundamental to the Nation's well-being; as policy, encourages exploration and development of mineral resources on National Forest System lands. The Agency's role in managing mineral resources is to provide reasonable protection of surface resources while allowing use of the land for operations authorized by US mining laws. To this end, the Secretary of Agriculture has authorized regulations (36 CFR 228) that ensure surface resource protection, while encouraging the orderly development of mineral resources on National Forest System lands (see minerals for more).

[23] All assumptions and methods used for this analysis can be found in volume 4 of the environmental impact statement, appendix B.

Roads

Roads convert productive soils to a non-productive condition for the life of the road. They therefore constitute an irretrievable, but not necessarily 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 use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, which are renewable only over long periods of time. Since soil productivity can typically be restored by applying remedial measures such as disking, scarification, revegetating, etc., loss of soil productivity is not necessarily irreversible. However, soil productivity is lost for the duration that a road exists on the landscape. Most of the precipitation that falls on compacted road surfaces becomes runoff. This runoff can entrain soil particles, resulting in erosion and loss of future productivity.

Wilderness Areas and Management Areas

Management associated with special areas, such as designated wilderness areas, recommended wilderness areas, research natural areas, and botanical areas, can minimize impacts associated with development and recreation. This management can be beneficial for soil condition through reduced effects to soils such as trampling, compaction, loss of vegetative cover and litter and associated accelerated erosion. Motorized and mechanized use is not allowed in designated wilderness (unless specifically allowed under special circumstances). These restrictions can reduce beneficial treatments in these areas primarily because motorized or mechanized equipment is often needed to thin areas prior to prescribed burning, control wildfires, and provide for firefighter safety. Increased fuel loads from reduced fuels management can increase the risk of high-severity wildfire, which can have detrimental impacts to soil condition and productivity.

Recommended wilderness areas would restrict the construction of new or permanent roads, new energy developments, and the extraction of mineral materials, all of which would reduce the effects associated with soil disturbance (see analysis under “roads” and “minerals” in this section). Eligible wild and scenic river segments have associated plan components that would restrict the construction of new roads (wild segments) and extraction of mineral materials. See the analysis under Roads and Minerals in this section. All plan components that enhance the free-flowing characteristics of that eligible segment would generally benefit soils by preventing excess erosion.

The Lakes and Rivers Management Area is an area with high levels of impacts from recreation such as trampling and erosion from water-based recreation. However, plan components for this management area would help manage already occurring recreation in that area and better plan for expected future demand. Plan components would benefit soils in this management area such as “Native riparian vegetation, natural streambank stability, floodplain and wetland function, and soil heath and stability should be maintained, or impacts mitigated from high-use recreation opportunities in the Lakes and Rivers Management Area” (LRMA-G 04).

The Salt River Horse Management Area will likely have a significant effect on soils where horses are present. Sensitive soils and riparian habitats may be damaged if a large number of horses are constantly trampling these areas. These large animals compact the soil, affecting future growth of natural vegetation. The effects would be similar to effects described in the Recreation and Riparian section.

Recreation and Riparian

Recreation can have negative effects on soil and vegetation. Among the recreation impacts, trampling is probably the most significant because it damages and destroys plants, displaces soil organic horizons, and compacts mineral soils. When vegetation is trampled, organic matter and root exudates are removed from the soil, reducing soil fertility. Compaction alters not only the soil's physical properties, but also its microorganisms. In addition to alleviating soil compaction, soil microorganisms are essential to the establishment and growth of vegetation; so, soil and vegetation are further altered by changes to the soil biota. Therefore, even in the absence of further trampling, sites can remain compacted and barren (Cole 2004).

On western rangelands, riparian areas are often the focal point for recreation. Recreationists are attracted to lakes and streams (Lime 1971, Clark and Downing 1985, Green 1998 and references therein). There are a number of functions provided by riparian systems that are not found in upland ecosystems. Stream ecosystems rely on these functions, such as bank stabilization and woody debris supply (Malanson 1993). Riparian areas have high value as wildlife habitats because of their ecological diversity and structural variation (Brinson et al. 1981). They also serve as nutrient and sediment sinks. There has been an increase in the use of, and impact on, riparian ecosystems with the growing popularity of all outdoor recreational activities. Recreational activities that are intense and persistent in a single area can have a number of negative effects on the riparian system. According to Green (1998 and references therein) the effects of soil compaction, litter removal, tree damage, root exposure, and shifts in animal and plant populations are among them. Undermining foundations and reducing soil thickness are both issues caused by rapid erosion rates. During the dry season of the year, decreased soil thickness results in reduced water holding capacity, an issue that is critical for many species. As the upper soil layer contains the bulk of plant nutrition, continued soil erosion also would further impoverish the site (Troeh and Thompson 1993).

All action alternatives incorporate management direction in the form of standards and guidelines aimed at improving riparian conditions and providing sustainable recreation opportunities within riparian areas in an attempt to alleviate the pressures recreation puts on the fragile soils in riparian areas. These plan components are described in further detail in the individual alternative sections below.

Mechanical Treatments

In all alternatives, timber harvesting or thinning operations can compact soil, which reduces the soils' ability to absorb water and nutrients. The amount of soil compaction is dependent on harvest methods, amount of slash in traffic lanes, operator technique, and soil conditions and properties (Page-Dumroese et al. 2010). Project-level activities would follow best management practices with mitigations that would result in minimal soil compaction. Ground cover may be disturbed during mechanical treatments (including the removal of vegetation) and may, therefore, result in some exposure of mineral soil. Although timber harvesting operations may result in some local soil movement, soil displacement and soil erosion are expected to be minor.

There are benefits to soils from mechanical treatments where there is accelerated erosion and impaired soil function due to lack of herbaceous cover. Mechanical and burning treatments reduce forest density and improve percentages of herbaceous cover, thereby stabilizing soils. As a benefit this greatly reduces the risk of high severity fire.

Wildfire and Wildfire Management

Wildland fire can negatively affect soil's physical, chemical, and biological characteristics. The most important physical characteristic of soil that affects its hydrologic function and stability is soil structure. The organic matter component, which provides for loose, granular structure, can be lost at relatively low temperatures. The loss of soil structure increases the bulk density of the soil and reduces its porosity, thereby reducing soil productivity and making the soil more vulnerable to post-fire runoff and erosion.

Organic matter lost due to soil heating during wildland fires negatively affects the most basic soil chemical properties (Neary et al. 2005). The amount of organic matter lost strongly depends on how long the fire residence time is, as well as how hot it burns. Soil organic matter plays a key role in nutrient cycling and exchange, and water retention in soils. As organic matter is burned, the nutrients stored in it escape into the atmosphere. By leaching or surface runoff and erosion, remaining nutrients are easily lost (Neary et al. 2005). Nitrogen is the most limiting organic nutrient because it is the only nutrient that is not derived from the breakdown of the parent material. Nitrogen is incorporated into the soil organic matter from the atmosphere (Neary et al. 2005). Nitrogen is volatilized at the lowest temperature, making it particularly important to mitigate nitrogen loss during fires on low-fertility sites which can only be replaced by nitrogen-fixing organisms.

Most cations (mineral nutrients in the soil) never evaporate and typically remain on the site in a highly accessible state. Following high severity fires, thick ash layers remain on the soil surface. These ash layers have an abundance of cations.

The areas most affected by high severity fires are those with low nutrients and thin soils. In a project area, fragile soils will be identified, and measures will be prescribed to protect them. Wildfires also affect soil biology. The response of soil microbes to fire depends on a number of factors, including fire intensity, site characteristics, and pre-burn community composition. According to most studies, microbial communities are resilient to fire. Fire severity typically affects the amount of time necessary for recolonization to pre-burn levels. Fires have the greatest impact on the forest floor (litter and duff). Forest floors, humus layers, and soil should be protected from wildfires that consume major fuel sources (Neary et al. 2005).

However, as a benefit burning increases the availability of most plant nutrients. Although some nutrients are volatilized during combustion, high concentrations of available plant nutrients on the soil surface immediately following fire may negate the advantage of fertilizing. Fire plays an important role in managing the ecosystems of the Tonto National Forest. The effects of wildfires can be mitigated by developing an informed burning prescription or selecting rehabilitation treatments following wildfires, even though they impact soil properties and cycling. Careful planning is required to ensure that fire-related soil changes do not adversely affect the long-term productivity of these ecosystems (DeBano 1991).

Alternative A Effects

Under alternative A current conditions would be maintained, however the direction towards desired condition may be at a slower rate in alternative A, than in other alternatives.

In alternative A sustainable recreation practices are not incorporated into the forest plan, though with the increase in population surrounding the Tonto National Forest recreation use and demand will only grow. Without involving sustainable recreation practices, recreation uses can impact soils with actives such as camping, hiking, mountain biking, horseback riding, etc. All of these activities may result in erosion and compaction. Impacts can vary from significant to non-significant on the forest. Implementing site-specific best management practices for recreation projects would minimize adverse soil impacts. Riparian lands are used to provide water access in the form of boat launching areas, swimming beaches, and fishing access points. These lands also provide support facilities in the way of campgrounds, picnic sites, and parking areas. Riparian land resources often experience substantial impacts when exposed to use by water recreationists. The impacts from recreation could occur under all alternatives, however without any integrated sustainable recreation practices, impacts in alternative A can be large and detrimental. Also see the Effects Common to all Alternatives, Recreation and Riparian section above.

The focus of riparian management is on improving vegetation, but no specific guidance is provided to improve ecological integrity under alternative A. Riparian zones are unique and dynamic systems. Major types of disturbance that impact these systems include management activities such as livestock grazing, timber harvest, recreational use, and the creation of physical structures like dams and roads, or natural perturbation such as fire. All of these activities will happen during the life of this plan and with no specific guidance to improve ecological integrity, the threat of soil loss and damage to riparian soils is at its highest in alternative A. The effects of disturbance on riparian soils are variable. Human disturbances tend to increase surface runoff in riparian systems, remove protective riparian vegetation, and alter the flow of water through aquatic systems. In particular, impacts of livestock grazing on riparian soils include soil compaction, breakdown of undercut streambanks, and increased loss of sediment due to excessive removal of stabilizing vegetation. Timber harvest increases soil erosion and alters soil microclimates by increasing soil temperatures. With no specific guidance to improve ecological integrity in alternative A recovery from activities in the riparian regarding soils become less probable.

For range management the assumption is that all currently open and vacant allotment are open, thus grazing would be a larger threat to soils in alternative A. Livestock and wildlife grazing has the potential to reduce soil condition through hoof compaction and the removal of protective vegetation and, subsequently, ground cover. The effects to soil condition would be reduced soil hydrologic function in highly compacted concentration areas and reduced soil stability from loss of ground cover wherever overutilization of available forage occurs. Site-specific best management practices would provide protection from the effects of grazing and are prescribed in project-level analysis. Also see the Effects Common to all Alternatives, Livestock Grazing section above.

Alternative B Effects

Alternative B includes vegetation management in frequent-fire ecosystems (ecological response units) and focuses on restoring fire as a key ecosystem process. This will be accomplished through a balance of mechanical treatments and fire. Also, under this alternative, objectives to restore grass and herbaceous cover are established for highly departed ecological response units (pinyon juniper grass and juniper grass) with the emphasis of using fire with some mechanical thinning. With increased ground disturbance, there would be an increased threat to soils; however, site-specific best management practices and mitigations would provide protection from the effects of wildfire and prescribed fire and are recommended at project-level analysis. Alternative B recommends fire to restore or maintain conditions in frequent-fire forested ecological response units (ponderosa pine forest, ponderosa pine – evergreen oak, and mixed conifer – frequent fire), emphasizing treatments within ponderosa pine – evergreen oak to reduce the brush component by: treating 50,000 to 122,000 acres over a 10-year period through mechanical thinning, and wildland fire (assuming about 22 percent prescribed fire); and treating 105,000 to 325,000 acres over a 10-year period with wildland fire (assuming about 22 percent prescribed fire). For more direct and indirect effects concerning wildfire management across landscapes regarding alternative B please see the Effects Common to all Alternatives, Wildfire and Wildfire Management section above.

Alternative B includes the following objective:

- Restore or maintain conditions in woodland ecological response units, emphasizing treatments within frequent fire woodlands (pinyon – juniper grass, juniper grass, Madrean pinyon oak) by treating 400 to 2,000 acres over a 10-year period with mechanical treatments and wildland fire; and treating 20,000 to 200,000 acres over a 10-year period with wildland fire (assuming about 22 percent prescribed fire).

Potential negative effects of mechanical treatments would be higher than alternative A: soil compaction, which reduces the soils' ability to absorb water and nutrients, could result from timber harvesting or thinning operations. The amount of soil compaction is dependent on harvest methods, amount of slash in traffic lanes, operator technique, and soil conditions and properties (Page-Dumroese et al. 2010). For more effects concerning wildfire management across landscapes regarding alternative B, also see the Effects Common to all Alternatives, Mechanical Treatments section above. Site-specific best management practices and mitigations would provide protection from the effects of mechanical treatments and are recommended at project-level analysis.

Alternative B is focused on maintaining and improving riparian conditions through the following objectives, standards and guidelines:

- Complete active and passive restoration projects on at least 125 miles of streams every 10 years to improve the ecological integrity of perennial and intermittent riparian ecosystems rated as nonfunctioning and functioning-at-risk (RMZ-O-01).
- Improve 10 to 15 individual springs during each 10-year period (RMZ-O-02).
- In riparian management zones, projects and management activities should be designed and implemented to maintain or restore long-term natural streambank stability, native vegetation, floodplain, and soil function (for activities within the Lakes and Rivers Management Area, reference guideline MA-LRMA-G-03) (RMZ-G-03).

This direction for restoration of riparian ecosystems focuses on reestablishing both structure and function of these systems, in reference to soils. The restoration of riparian ecosystem functions such as filtering, buffering, and nutrient cycling are difficult to evaluate directly, and although these components are challenging to measure, riparian restoration will reestablish these functions. Regarding soils: riparian restoration in alternative B, will benefit chemical and physical indicators of soil quality. In alternative B over the long term, riparian restoration will be ideal for soil quality indicators such as integration of soil physical, chemical, and biological properties; Soil carbon; nitrogen; bulk density; infiltration; available water capacity; aggregate stability; and soil organism populations.

The following objective is included in alternative B for range:

GRZ-O-02 At least one vacant allotment will be evaluated for one of the following options every two years, until there are no vacant allotments. If additional allotments become vacant (waived without preference) they will be evaluated for one or a combination of the following options within two years:

a. Convert to forage reserves to improve resource management flexibility;
b. Grant to current or new permitted livestock producer; or
c. Close to permitted grazing, in whole or in part.

With this direction although the grazing of livestock will have its negative impacts (please see the Effects Common to all Alternatives, Livestock Grazing section above), impacts to soils can be reduced and mitigated with well managed allotments. This includes reduced soil erosion; improved air and water quality; better plant diversity, vigor and production; as well as improved fish and wildlife habitat. This alternative improves grazing management with its objective, which can result in more vegetative cover and improved soil structure that will allow a higher percentage of the rainfall to infiltrate the soil where it can be used for plant growth rather than running off where it can result in soil erosion and sedimentation issues. The overall soil quality improves with improved grazing management under alternative B. It should also be noted that site-specific best management practices and mitigations would provide additional protection from the effects of grazing and are recommended as part of project-level analysis and design.

Alternative B emphasizes sustainable recreation opportunities that are managed to balance public demand and natural resource desired conditions, aimed at “right sizing” opportunities on the forest. There is also an assumption that there is a potential for proposing new roads and trails (motorized and nonmotorized). Roads and trails convert productive soils to a non-productive condition for the life of the road or trail (please see the Effects Common to all Alternatives, Roads section above), they therefore constitute an irretrievable, but not necessarily irreversible commitment of soil resources. Recreational uses such as camping, hiking, mountain biking, horseback riding can have negative effects on vegetation and soils. Regarding recreation, the nature and effects of its impacts particularly on vegetation and soil can be negative. Trampling, from recreational uses is probably the most prevalent recreation impact process, damages and kills plants, displaces soil organic horizons, and compacts mineral soils (please see the Effects Common to all Alternatives, Recreation section above). With the increase in population surrounding the Tonto National Forest, recreation use and demand will only grow. Incorporating sustainable recreation practices as direction in the forest plan can minimize impacts from recreational use when combined with site-specific best management practices and mitigations. Recreational uses under alternative B can have an impact to soils with actives which can include (but are not limited to) camping, hiking, mountain biking, horseback riding, etc.

Approximately 43,204 acres are analyzed as recommended wilderness for alternative B. Of the wilderness additions. With the additional management direction restrictions that comes with wilderness and recommended wilderness, soil as resource would benefit due to less disturbances in those areas.

Alternative C Effects

This alternative would have similar effects to soils as alternative B, although under this alternative vegetation management in frequent-fire ecosystems/ecological response units would rely on fire as the primary restoration tool. Mechanical thinning would only be used in limited situations (e.g., wildland-urban interface areas or invasive species treatments). Therefore, just like in alternative B, ground disturbance from fire and mechanical treatment, so there would be a threat to soil. Alternative C includes the following objective:

- Restore or maintain conditions in frequent-fire forested ecological response units (ponderosa pine forest, ponderosa pine-evergreen oak, and mixed conifer–frequent fire), emphasizing treatments within ponderosa pine forest to reduce the brush component by: treating 11,000 to 22,000 acres over a 10-year period through mechanical thinning, and wildland fire (assuming about 22 percent prescribed fire); and treating 144,000 to 410,000 acres over a 10-year period with wildland fire (assuming about 22 percent prescribed fire).

Wildland fire and fire management may negatively affect soil’s physical, chemical, and biological characteristics. The most important physical characteristic of soil that affects its hydrologic function and stability is soil structure. The organic matter component, which provides for loose, granular structure, can be lost at relatively low temperatures. The loss of soil structure increases the bulk density of the soil and reduces its porosity, thereby reducing soil productivity and making the soil more vulnerable to post-fire runoff and erosion. Loss of organic matter due to soil heating during wildland fires negatively affects the most basic soil chemical properties (Neary et al. 2005). (Also see the Effects Common to all Alternatives, Wildfire and Wildfire Management section above). It should also be noted that site-specific best management practices and mitigations would provide the best protective measures from the effects of fire (wildfire and prescribed fire) and are recommended at project-level analysis.

Alternative C includes the following standard:

- If a riparian area is non-functioning, as identified in the Proper Functioning Condition Assessment framework or similar protocol, all permitted and allowed uses will be removed until riparian recovery is achieved.

Like in alternative B, this direction for restoration of riparian ecosystems focuses on the reestablishment of both structure and function of these system, in reference to soils. The restoration of riparian ecosystem functions such as filtering, buffering, and nutrient cycling are difficult to evaluate directly, and although these components are challenging to measure, riparian restoration will reestablish these functions. Riparian restoration in alternative C will benefit chemical and physical indicators of soil quality. In alternative C, over the long term, riparian restoration will be ideal for soil quality indicators such as integration of soil physical, chemical, and biological properties; soil carbon; nitrogen; bulk density; infiltration; available water capacity; aggregate stability; and soil organism populations. It should be noted the recovery period for soils is long and well beyond the life of this plan.

The following objective for range in included in alternative C:

All currently vacant allotments would become open, and the following objective would be included under alternative C:

- At least one vacant allotment should be evaluated and closed to permitted grazing every two years, until there are no vacant allotments. If additional allotments are waived without preference, they will be evaluated and closed as part of the above two year timeframe.

Like alternative B, alternative C with this direction although the grazing of livestock will have its negative impacts (please see the Effects Common to all Alternatives, Livestock Grazing section above), impacts to soils can be reduced and mitigated with well managed allotments. This includes reduced soil erosion; improved air and water quality; better plant diversity, vigor and production; as well as improved fish and wildlife habitat. This alternative allows for improving grazing management, which can result in more vegetative cover and improved soil structure that will allow a higher percentage of the rainfall to infiltrate the soil where it can be used for plant growth rather than running off where it can result in soil erosion and sedimentation. The overall soil quality improves with improved grazing management, which is in alternative B. Site-specific best management practices and mitigations would provide additional protection from the effects of grazing and are part of project-level design.

The focus of recreation management for alternative C is that sustainable recreation opportunities are managed to emphasize more primitive recreation. Consequently, there would be less potential for new roads and trails (motorized and nonmotorized). Roads and trails convert productive soils to a non-productive condition for the life of the road or trail (please see the Effects Common to all Alternatives, Roads section above). They therefore constitute an irretrievable, but not necessarily irreversible commitment of soil resources. Under the assumption that there is a potential for less roads and trails, soils would benefit more in alternative C regarding recreation than B. Recreational uses such as camping, hiking, mountain biking, horseback riding can have negative effects on vegetation and soils. Trampling, from recreational uses damages and kills plants, displaces soil organic horizons, and compacts mineral soils (please see the Effects Common to all Alternatives, Recreation and Riparian section above). With the increase in population surrounding the Tonto National Forest, recreation use and demand will only grow. Incorporating sustainable recreation practices as direction in the forest plan, impacts from recreation use can be minimized when combined with site-specific best management practices.

Approximately 399,029 acres are analyzed as recommended wilderness for alternative C. The additional management direction provided for recommended wilderness would benefit soil due to less disturbances in those areas.

Alternative D Effects

This alternative would have many similar effects to soils as alternative A, B and C. Although vegetation management in frequent-fire ecosystems/ecological response units would rely on mechanical treatment and timber harvest as the primary restoration tool, causing ground disturbance. Mechanical treatment from timber harvesting or thinning operations can cause soil compaction, which reduces the soils' ability to absorb water and nutrients. The amount of soil compaction is dependent on harvest methods, amount of slash in traffic lanes, operator technique, and soil conditions and properties (Page-Dumroese et al. 2010). Project-level activities would follow best management practices and develop mitigations that would result in minimal soil compaction (please see the Effects Common to all Alternatives, Mechanical Treatments section above). Some areas will be treated with fire (please see the Effects Common to all Alternatives, Wildfire and Wildfire Management section above). Wildland fire and fire management may negatively affect soil's physical, chemical, and biological characteristics. The most important physical characteristic of soil that affects its hydrologic function and stability is soil structure. The organic matter component, which provides for loose, granular structure, can be lost at relatively low temperatures. The loss of soil structure increases the bulk density of the soil and reduces its porosity, thereby reducing soil productivity and making the soil more vulnerable to post-fire runoff and erosion. Alternative D seeks to restore or maintain conditions in frequent-fire forested ecological response units (ponderosa pine forest, ponderosa pine-evergreen oak, and mixed conifer-frequent fire) through more intensive mechanical treatments (forest products focus):

- Treating 50,000 to 190,000 acres over a 10-year period with mechanical thinning and wildland fire. (Assume about 22 percent prescribed fire)
- Treating 16,000 to 62,000 acres over a 10-year period using wildland fire. (Assume about 22 percent prescribed fire

It should also be noted that site-specific best management practices and mitigations would provide the best protective measures from the effects of mechanical treatment and thinning and are recommended at project-level analysis.

Alternative D states the following regarding range "open allotments as they become vacant, assume all allotments currently vacant are open." Allotments that become vacant will be opened, resembling Alternative A. Grazing contributes to the risk of invasive plant infestation and spread. Grazing and trampling cause (1) the removal of native plants, clearing vegetation, (2) destruction of soil crust and preparation of weed seedbeds through hoof action by establishing openings and uncovering soil, and (3) the transport and dispersal of invasive weeds seeds from one area to another (Parks et al. 2005). All of these actions are threats to soil; however, with the use of adaptive management strategies the threats to soil can be minimized.

In alternative D, the riparian section is similar to alternative A, however there is specific guidance to improve ecological integrity, focused on maintaining current riparian conditions. Alternative D also has a guideline that states that in perennial and intermittent riparian stream courses, project and management activities should be designed and implemented to maintain natural streambank stability, native vegetation, and riparian, floodplain, and soil function. A result of this could bring riparian areas to a desired condition regarding soils in alternative D at a slower rate than alternatives B and C.

The focus for alternative D, is sustainable recreation opportunities are managed to favor motorized and sustainable recreation. There is also an assumption that there is a potential for more new roads and trails (motorized and nonmotorized). Roads and trails convert productive soils to a non-productive condition for the life of the road or trail (please see the Effects Common to all Alternatives, Roads section above), they therefore constitute an irretrievable, but not necessarily irreversible commitment of soil resources. Regarding recreation the nature and effects of its impacts particularly on vegetation and soil can be negative. Trampling is probably the most prevalent recreation impact process, which damages and kills plants, displaces soil organic horizons, and compacts mineral soils (please see the Effects Common to all Alternatives, Recreation and Riparian section above). With the increase in population surrounding the Tonto National Forest recreation use and demand will only grow. With sustainable recreation practices as direction, as well as site-specific best management practices and mitigations, impacts from recreation can be minimized.

Cumulative Effects

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current conditions (as detailed in the description of the affected environment and alternative A) as proxies for the impacts of past and present actions. This is because existing conditions reflect the aggregate impact of all prior actions.

Time Boundary for Analysis

The process of soil recovery is extremely long and can take multiple lifetimes in most cases to fully restore and recover. The time frame used for this cumulative analysis is the 30-year life span of this forest plan. It is unlikely desired conditions could be reached within that time period; however, by following objectives, standards, guidelines and management approaches in respects to soils, it is foreseeable that the Tonto National Forest will be on an adjusted pathway toward better soil quality within 30 years.

Rationale for time boundary is as follows:

- Funding levels have been low and are not expected to increase in the near future.
- The process of soil recovery is extremely long and can take multiple lifetimes in most cases to fully restore and recover.
- With an increasing population of people encroaching the Tonto National Forest, the concern for soil degradation only increases. The fact that the Tonto National Forest borders the fifth largest city in the United States and the population is expected to only grower larger, means that human activity on the landscape will only grow larger as well. This will be a constant foreseeable challenge for soils.

Spatial Boundary for Analysis

The analysis area for this environmental impact statement is the entire Tonto National Forest.

Ongoing and Reasonably Foreseeable Actions

In terms of reasonably foreseeable future actions, this analysis has attempted to include, specific to soils resources and projects for which upcoming actions are known and can be meaningfully analyzed.

Restoring and maintaining resilience in forest ecological response units are part of the basic elements of forestwide desired conditions, and other plan components in alternatives B, C, and D. Restoring and maintaining resilience would improve the potential for ecosystems to retain or return to desired conditions after being influenced by stressors and forest activity-related impacts and variability. Management practices (e.g., thinning for age class diversity and structure, and reclaiming and restoring native riparian) that sustain healthy plant and animal communities, and provide adequate nutrients, soil productivity, and hydrologic function promote resilience and reduce opportunities for disturbance and damage.

Since there is expected to be continued growth in urban areas in and around the Tonto National Forest, it is reasonably foreseeable that ground disturbances (via forest projects and public demand) will further stress all forest resources, which can all have a significant impact on soils. Management focuses on maintaining and improving soil quality. These efforts, in combination with similar efforts of other agencies and landowner groups would have a positive effect towards soil desired soil condition.

Other past, present and future activities may potentially contribute to cumulative effects on plant communities and soils. Virtually any activity, including management activities called for in plan components, which create disturbance have the potential to affect soils. Specifically, resources which drive changes referring to vegetation management, wildfire management, rangeland management, recreation management, riparian management and mining and minerals all include activities that have occurred, are occurring, or will continue to occur; will impact soils on the Tonto National Forest to some degree.

Cumulative environmental consequences to soils are considered to occur on-site and are affected by activities that occur or re-occur at the same place over time. Permanent loss of soil productivity has and would affect the level of future goods produced and beneficial uses provided by the forest in the future. Potential cumulative environmental consequences from other landowners, when added to the environmental consequences listed above, include the following:

- Soil loss through wind or water erosion leaving the forest or coming onto the forest, would potentially reduce soil productivity due to soil deposition on the receiving lands.
- Airborne deposition of pollutants, including soil, could potentially reduce soil productivity; however, this is currently not contributing to a measurable reduction, and it is not expected to in the future (see Air Quality section).

Caves and Karsts

Caves are natural biophysical features that include any naturally occurring void, cavity, recess, or system of interconnected passages beneath the surface of the Earth or within a cliff or ledge that is large enough to permit a person to enter, whether the entrance is excavated or naturally formed (16 USC Ch. 63 Sec. 4302). This definition includes any fissure (large crack), lava tube, natural pit, sinkhole, karst feature or other opening which is an extension of a cave entrance, or which is an integral part of the cave.

Affected Environment

Cave resources include any material or substance occurring naturally in caves such as plant and animal life, paleontological deposits, sediments, minerals, cave formations, and cave relief features. Many caves also have important traditional cultural significance to regional area Tribes and pueblos. Most cave resources are not replaceable and not renewable.

The Tonto National Forest contains many significant caves and karst resources. The Federal Cave Resources Protection Act of 1988 (16 U.S.C. 4301-4309; 102 Stat. 4546) defines a significant cave as a cave located on National Forest System lands that has been evaluated and shown to possess features, characteristics, values, or opportunities in one or more of the following resource areas: biota; cultural; geologic-mineralogic-paleontologic; hydrologic; recreational; or educational-scientific for scientific, educational or recreational purposes; and which has been designated “significant” by the Forest Supervisor.

Caves provide specialized seasonal and year-round habitats for a variety of wildlife species, including bats, cliff-nesting birds, snails, reptiles, amphibians, and insects. Other small and large mammals also use caves opportunistically.

There are currently 75 known caves and possibly more than 100 caves located within the Tonto National Forest. Most of these caves are located in proximity to exposures of on or near surface limestone with a few exceptions of aeolian formed caves found in volcanic tuff. Caves are a type of groundwater-dependent ecosystem, and their formation and continuing formation is due to groundwater percolating through fractures and dissolving carbonate rocks located in the forest. A comprehensive inventory of the caves has not been conducted, and there is high potential that groundwater dependent fauna and microorganisms exist in the cave systems. Currently the Tonto National Forest has deemed 17 caves with significant status. These caves contain outstanding karst features including stalactites, stalagmites, flowstones, soda straws, drapes, columns, and cauliflower calcite. Of the 75 known caves, 40 have been surveyed with plans to continue the efforts on other caves in the future. Caves are prime habitat for some wildlife species including multiple species of bats and other endemic species including many invertebrate species, packrats, cliff-nesting birds, snails, reptiles, and amphibians.

Environmental Effects

Regardless of the alternative, all caves will be managed in accordance with the Federal Cave Resources Protection Act of 1988 (102 Stat. 4546; 16 U.S.C. 4301 et seq) and direction in FSM 2880 and FSM 2356

Regardless of the alternative, all caves will be inventoried, significance will be determined, and appropriate management will be provided to protect the cave resources.

The environmental effects to caves from activities that are proposed in the alternatives could affect air quality, groundwater geochemistry, and sediment levels in caves. In addition, cave resources that include cave fauna and flora, paleontological and archaeological resources, and speleogens and speleothems could be affected.

Effects Common to all Alternatives

Vegetation management includes thinning and/or removal of vegetation with mechanical equipment. The result of this treatment is disturbance to soil in the form of reduced soil porosity (soil compaction) and decreased ground cover. During rainfall and snow melt events erosion could accelerate and sediment delivery rates could increase. Increased sediment rates in areas that drain into caves could result in additional sediment deposits over and beyond the normal range of distribution of sediment deposition in cave systems. Cave systems could become inundated with sediment, and cave resources could be damaged. However, within a few years post treatment, herbaceous ground cover will greatly increase, resulting in better soil conditions and hydrologic response in the future. Lower density forest conditions will also result in more snow and rainfall reaching the soil surface instead of canopy interception and evaporation.

Recreation operations with the potential to affect caves include but are not limited to expanding or constructing new campgrounds, extending existing trails, maintaining existing trails and roads, constructing new trails and roads, or otherwise increasing accessibility to the caves. Septic systems are used in campground facilities to treat human-generated waste. Depending on the location of these septic systems, ground water that moves through caves could be contaminated. This contaminated groundwater could negatively impact cave resources.

Encouraging more people to use trails in the vicinity of caves, along with social media advertising the location of caves and unique recreation destinations, can result in cumulative cave damage. Touching the walls of caves can leave residual matter that over time can have a visual effect. Lint, hair, skin cells, and other residual matter can result in an adverse biological change to the cave.

The addition of specified vegetation management practices and recreational operations would help mitigate the potential for cave resource degradation.

Alternative A Effects

Alternative A from the current 1985 forest plan states the forest will preserve and protect cave ecosystems as nonrenewable resources to maintain their geological, scenic, educational, cultural, biological, hydrological, paleontological, and recreational values. All surface-disturbing activities planned near or within a known cave area will be examined for potential impacts to the cave(s) and the area around each cave entrance(s), (plus feeder drainages and surface areas immediately over cave passages). The cave area will also be evaluated to determine protection measures needed. Protection measures for caves will be incorporated into project planning and may include (but not be limited to) education, seasonal closures, and installation of entrance gates. Develop a forestwide cave implementation plan and use it as a basis for preparation of prescriptions for significant caves and any other selected cave. Evaluate appropriateness of recreation activities as a part of the plan. Bat roosts and other sensitive biological resources within caves will be managed using all appropriate means identified in the cave implementation plan. Potential impacts to cave resources will be considered in reviewing all proposed Notices of Intent/Plans of Operation. Appropriate land will be with-drawn from mineral entry when necessary to provide cave protection.

In alternative A, mechanical thinning objectives are lower than in other alternatives, therefore negative effects from mechanical thinning, as identified in the Effects Common to All Alternatives section, are low compared to other alternatives.

Alternate A provides a baseline to which the forest can use additional plan components moving forward integrating other programs consisting of but not limited to grazing, fire, and recreation. These additional components would allow the forest to move forward with public awareness and education with the recent addition of new significant caves.

Alternative B Effects

Alternative B includes plan direction that allows for adaptive management to address changing conditions while managing for sustainable multiple uses. Management of vegetation, recreation, rangeland, timber harvest, and other activities would be used to maintain the integrity of the forest cave system.

Vegetation management in frequent-fire ecosystems/ecological response units focuses on restoring fire as a key ecosystem process. This is accomplished through a balance of mechanical treatments and prescribed burning – with the emphasis of mechanical first entry treatments followed by prescribed burning afterwards.

Alternative B provides for a balance of motorized and nonmotorized recreation opportunities. An increase in nonmotorized trails may increase visitation to caves, potentially resulting in more human impacts to caves. These may include increased litter and graffiti, chemical and biological changes to the cave environment (i.e., from human waste, campfires, and other non-natural foods or materials brought into the caves), and a spread of invasive species. These effects are more than alternative C but less than alternative D, with alternative B providing a balance between different types of recreation. If caves are located near a motorized trail and do not require much deviation from the motorized trail to experience the cave, visitation may also increase, along with the impacts noted above.

Alternative C Effects

Alternative C emphasizes primitive recreation opportunities, increased protections to natural resources, use of natural processes for restoration, limiting some aspects of grazing, and prioritizing natural resources over some economic development opportunities.

Vegetation management in frequent-fire ecosystems/ecological response units relies on prescribed fire as the primary restoration tool. Mechanical thinning would only be used in limited situations (e.g., wildland-urban interface areas or invasive species treatments). As a result, fewer commercial forest products would be available, and fewer suitable timber acres would be treated. This would result in less soils to erode and drain into caves, damaging cave resources and conditions.

Closing grazing allotments in alternative C may decrease the manure content and sediment load related to water run-off that leads to caves and cave formations. This may improve cave conditions or otherwise alter the formation process if the cave has historically had grazing near it. Many cave entrances are located on or below surface level and are hence suspectable to overland flow.

Alternative C plan direction would close riparian management zones that are determined to be non-functioning and would remain closed until recovery can be achieved. This may affect both access to caves (by limiting all uses and access to the cave if it lies within the riparian area) and water qualities contributing to cave formation. As the riparian area approaches desired conditions, water qualities would likely improve and may either improve or hinder cave formation, depending on the history of the cave formation. If the riparian area was non-functioning due to a lack of healthy vegetation, and during closure the area has improved vegetation density, this may restrict water availability for the cave to continue to form.

Alternative C emphasizes primitive and nonmotorized recreation opportunities. An increase in management and construction of nonmotorized trails may increase visitation to caves, potentially resulting in more human impacts to caves. These may include increased litter and graffiti, chemical and biological changes to the cave environment (i.e., from human waste, campfires, and other non-natural foods or materials brought into the caves), and a spread of invasive species. These effects are higher than in both alternatives B and D, which provide for more motorized recreation opportunities.

Alternative D Effects

Alternative D also emphasizes active restoration techniques to achieve desired conditions and provides for more economic opportunities on the forest including grazing, mining, and motorized recreation.

Vegetation management includes thinning and/or removal of vegetation with emphasis on mechanical treatments. The result of this treatment is similar to that of alternative B, but with higher probability of sediment rates increasing and depositing soils into cave systems. Caves are likely to receive more damages to resources and conditions.

Vegetation management in frequent-fire ecosystems/ecological response units focuses on restoring conditions primarily through mechanical treatments and focuses on increasing the supply of forest products. Fire is still managed to meet resource objectives; however, prescribed burning is mainly focused in areas that have been previously thinned.

Alternative D emphasizes accessible and motorized recreation opportunities. An increase in management and construction of motorized trails should not affect caves unless there are identified caves near motorized trails. For caves that do not require much deviation from a motorized trail to experience the cave, visitation may increase resulting in more human impacts to caves. These may include increased litter and graffiti, chemical and biological changes to the cave environment (i.e., from human waste, campfires, and other non-natural foods or materials brought into the caves), and a spread of invasive species. For caves specifically near OHV areas, additional damages from motorized vehicles may also affect the condition of caves (tire tracks, features being run over, and noise from sound systems).

If a given cave is a popular recreation destination and it is determined that a designated nonmotorized trail is required to protect other resources (i.e., soils, vegetation, and water qualities experiencing impacts from user-created trails to the cave), then visitation to the cave may also be increased. Proper protection measures would then be included to plan for additional visitation and to protect the unique features, characteristics, and values of the cave. For caves that require backcountry travel on nonmotorized trails or through general Forest lands that are not already a popular recreation destination, caves should not be affected as much by alternative D because recreation management focuses on motorized uses.

Cumulative Effects

This cumulative effects analysis does not attempt to quantify the effects of past actions by adding up all prior actions on an action-by-action basis. In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current conditions (as detailed in the description of the affected environment) as a proxy for the impacts of past and present actions. This is because existing conditions reflect the aggregate impact of all prior actions and natural events.

This analysis focuses on the cumulative impact of those reasonably foreseeable actions that are relevant in assessing the impacts of revising the forest plan.

The analysis area for cumulative effects includes the Tonto National Forest and adjacent public lands including the Prescott National Forest, Coconino National Forest, Apache-Sitgreaves National Forest, Coronado National Forest, Tonto National Monument, Bureau of Land Management lands, Arizona State lands, Tribal lands, and the numerous counties and municipalities that overlap or are located in the immediate vicinity of the Forest. The temporal bound for this analysis is the life of the forest plan, which is estimated to be 10 to 15 years.

Continuous access and recreational use of caves could result in degradation of cave resources. Historical documentation and social media are the main ways caves are made to be public knowledge and increase visitation. Also, the continued growth in population of the greater Phoenix metropolitan area adds pressure to the already stressed ecosystem. Local educational forums, outdoor adventure programs, historical programs, and other land management agencies providing information on caves may increase public awareness and encourage the public to seek out caves on the Tonto National Forest. Providing this recreational experience to the public helps achieve desired conditions of dispersed recreation (REC-DIS-DC-01), but may impact desired conditions of the caves, such as “The cultural, archaeological, geological, hydrological, paleontological, biological, and aesthetic resources associated with caves and karst features are conserved, maintained, and not degraded by visitors” (CVK-DC-01). As the public is made aware of caves and the unique characteristics they possess, visitation to caves on the Tonto National Forest is expected to increase, along with the resulting human impacts addressed above.

In addition, multiple disturbances within the drainage area of a cave entrance can result in sedimentation of the cave. These disturbances could include wildfire, prescribed fire, mechanical treatment of vegetation, or construction. For these activities occurring on lands adjacent to the Tonto or on inholdings, affects may result to the Tonto National Forest caves. Soil disturbance in the form of reduced soil porosity (soil compaction) and decreased ground cover could accelerate and sediment delivery rates could increase. Increased sediment rates in areas that drain into caves could result in additional sediment deposits over and beyond the normal range of distribution of sediment deposition in cave systems. Cave systems could become inundated with sediment, and cave resources could be damaged. Within a few years post treatment, herbaceous ground cover will greatly increase, resulting in better soil conditions and hydrologic response in the future. Lower density forest conditions will also result in more snow and rainfall reaching the soil surface instead of canopy interception and evaporation. These benefits on adjacent lands could extend to lands on the forest.

In terms of reasonably foreseeable future actions, this analysis has attempted to include, specific to caves and karst resources, projects for which upcoming actions are known and can be meaningfully analyzed. What will not be analyzed are projects that are inevitable and known, but which have not yet developed proposed actions.

Ongoing and reasonably foreseeable actions, with the emphasis on cave and karst protection would include occasional monitoring of grazing allotments, timber harvest sections and post burn areas to assess the health and condition of the features. Caves would be visited periodically to assess visitation and accessibility by humans and wildlife.

Air Quality

Air quality has long been recognized as an important resource for national forests to protect, and as the public has long come to value the fresh air and sweeping views in these forests, forest officials have had to pay increasingly close attention to these air quality considerations. Not limited to aesthetic concerns, however, air quality plays a subtle but critical role in the overall health of the forest ecosystem – all of its biotic communities both, botanical and zoological. This is especially the case whenever components in the air are directly deleterious to plant respiration and metabolism, or which are indirectly injurious through degradation of water and soil quality. Furthermore, in certain air quality conditions, the respiratory health of the forest officials and visitors themselves can be compromised.

Air quality on the forest is connected to several valued services, including fresh air and clear views. Air pollution is a "moveable feast" and air quality on the Tonto National Forest has been and is being affected by the neighboring mining activities in Gila and Pinal Counties and by air pollutants generated from urban Phoenix. Pollution (e.g., industrial sources, dust, and smoke from wildland fires) generated both on and off the forest can impact these services. Other impacts may include the deposition of nitrogen and sulfur species (such as nitrates and sulfates), which ultimately affect other forest resources (e.g., species, water quality). Furthermore, ground-level ozone concentrations are sufficiently elevated to adversely affect the coniferous forests.

The following qualitative analysis describes general trends and projected conditions in relation to the National Ambient Air Quality Standards and Regional Haze Rule (Environmental Protection Agency, 2017) as described in the State Implementation Plan (Arizona Department of Environmental Quality, 2011). Any differences in projected conditions due to proposed forest activities are described in the environmental effects section and specialist report in the project record.

Affected Environment

A portion of the Tonto National Forest falls within Arizona's sulfur dioxide (SO_2) nonattainment area, based on standard promulgated in 2021 (EPA 2021) near Miami and Globe, Arizona.

In addition, Section 169A of the Clean Air Act sets forth a national goal to prevent any future (and the remedying of any existing) impairment of visibility in Class I areas from human- caused emissions. The Regional Haze Rule, 40 CFR 51, calls for states to establish goals and emission reduction strategies for improving visibility in all mandatory Class I national parks and wilderness areas. The national visibility goal for each Class I area is to return to natural visibility conditions by 2064.

The Tonto National Forest has three visibility monitoring sites (there are about 150 nationwide): at the Tonto National Monument, in the Sierra Ancha Wilderness Area, and at Queen Valley. All three sites through the 2000s showed moderate improvements in visibility. Nonetheless, all three sites would have to improve visibility from the 2000 to 2004 "baseline" conditions by about 50 percent to meet the long-term visibility goal of 2064. The Interagency Monitoring of Protected Visual Environments (IMPROVE) program has been monitoring visibility conditions in Class I wilderness areas in Arizona and nationwide since the late 1980s (IMPROVE 2018). This is a consortium of various Federal, State, and Tribal agencies. The IMPROVE network measures concentrations of atmospheric aerosols (sulfates, nitrates, etc.) and uses these data to estimate "light extinction", which is the degree to which light is absorbed and/or scattered by air pollution.

Altogether, Arizona has twelve Class I areas: four of them—all wilderness areas—are near or within the Tonto National Forest: Pine Mountain, Mazatzal, Sierra Ancha, and Superstition. In addition to these Class I areas, the Tonto National Forest includes four other wilderness areas designated after 1977:

Hellsgate, Salome, Four Peaks, and Salt River Canyon. All eight of these wilderness areas are managed in a similar way, with the goal being to preserve and, if possible, enhance the air quality in those areas. Moreover, their visibility characteristics are adequately monitored by the three IMPROVE sites.

In addition to the Class I areas, sensitive areas also include those portions of south-central Arizona which have, in the recent past or at present, failed to achieve various air quality standards. Several such nonattainment areas lie near the Tonto National Forest or include parts of its domain: the Maricopa County particulate matter 10 (PM_{10}) and ozone nonattainment areas, the Payson particulate matter 10 (PM_{10}) maintenance area, Miami nonattainment areas for sulfur dioxide and particulate matter 10 (PM_{10}), and the Hayden nonattainment areas for particulate matter 10 (PM_{10}), sulfur dioxide, and lead. It should be noted that Hayden lies some 20 miles south of the nearest forest property; that the Miami and Globe nonattainment areas contain extensive acreages of the forest, and that the southwester most portions of the forest lie within the Maricopa County nonattainment areas for particulate matter 10 and ozone. Each one is described in more detail in the Tonto National Forest Air Quality Assessment Report.

The 2012 Planning Rule requires national forests to consider air quality when developing their plans. For more information about air quality conditions, please refer to the Air Quality Assessment report prepared for the Tonto National Forest in June 2015 (AES 2015). The Arizona Department of Environmental Quality and the Environmental Protection Agency have jurisdiction over air quality in the Tonto National Forest. Arizona Department of Environmental Quality is delegated to prepare State Implementation Plans for the areas in the state not meeting the National Ambient Air Quality Standards.

As examples of visibility near or within the Tonto National Forest, figure 2, figure 3, and figure 4 depict the visibility given in deciviews for the three IMPROVE monitoring sites for 2007 - 2018: Queen Valley; Sierra Ancha Wilderness; and Tonto National Monument. In the charts below, please note that the uniform rate of progress is the calculation of the slope of the line between baseline visibility conditions and the natural visibility condition over the 60-year period to 2064. For the first regional haze plan, the first benchmark is the deciview level that should have been achieved in 2018 (Arizona Department of Environmental Quality 2011). The deciview scale is nearly zero for a pristine atmosphere, and each deciview change corresponds to a small but perceptible scenic change that is observed under either clean or polluted conditions. Like the decibel scale for sound, similar changes in deciviews are perceived as equal. As examples, 1.8 deciviews equals 200 miles of visual range; 14 deciviews equals 60 miles of visual range; and 30 deciviews equals a visual range of 12 miles. So, the lower the deciview value the cleaner the air is. Each chart presents the visibility of the haziest and cleanest days for each year; and each gives the natural conditions.

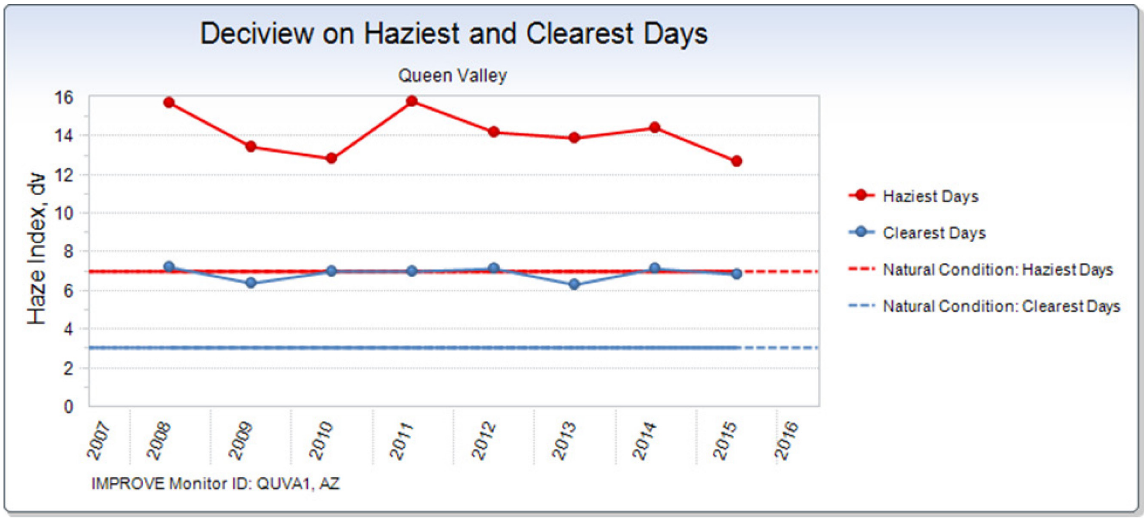

Figure 2. Visibility in Queen Valley

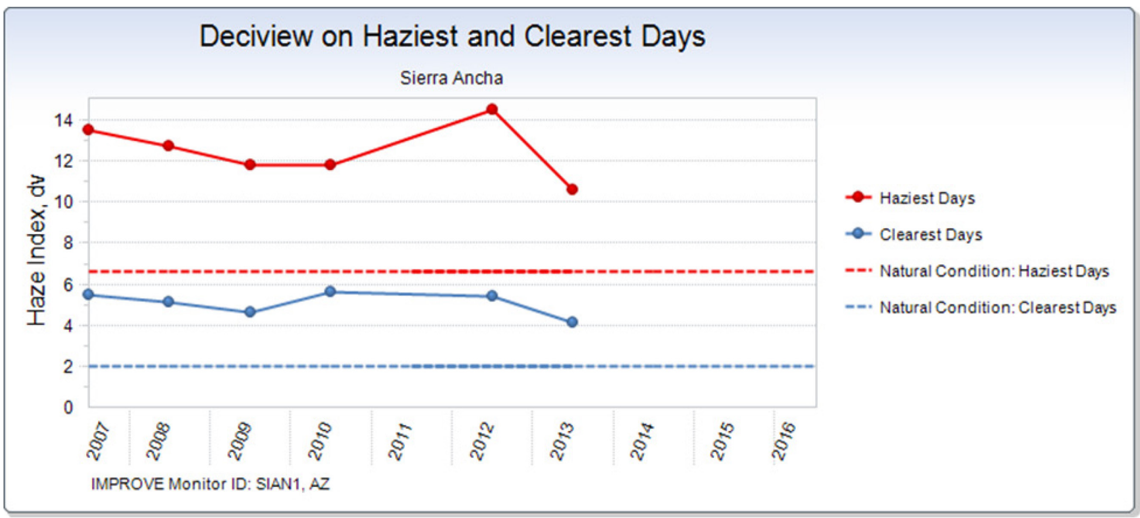

Figure 3. Visibility in the Sierra Ancha Wilderness Area

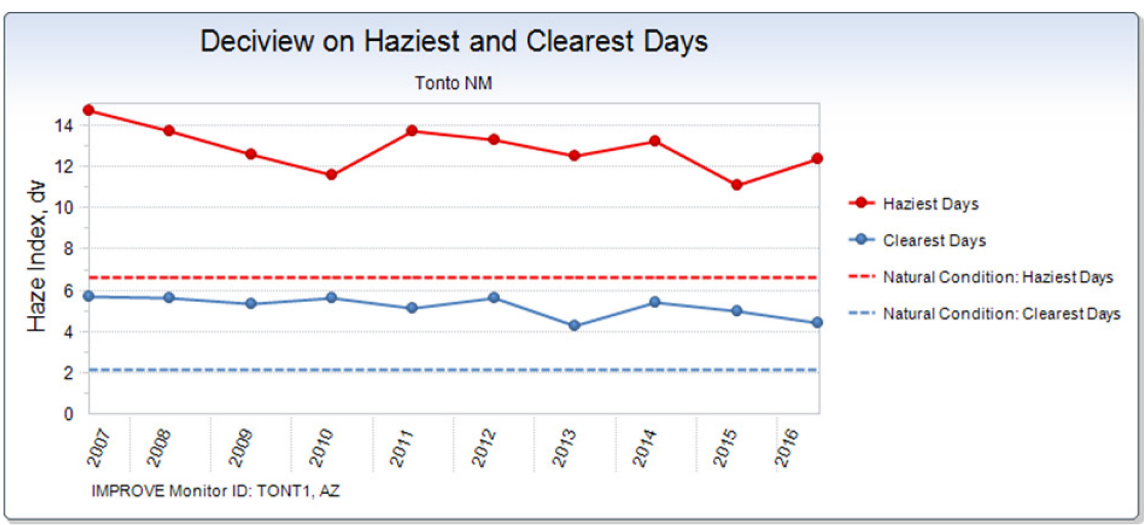

Figure 4. Visibility at Tonto National Monument

While visibility has been either steady or slightly improving through these years, considerably additional improvements would be necessary to reach the goal of natural conditions. Figure 5 and figure 6 show details of the composition of the aerosols that degrade visibility for the Tonto National Monument.

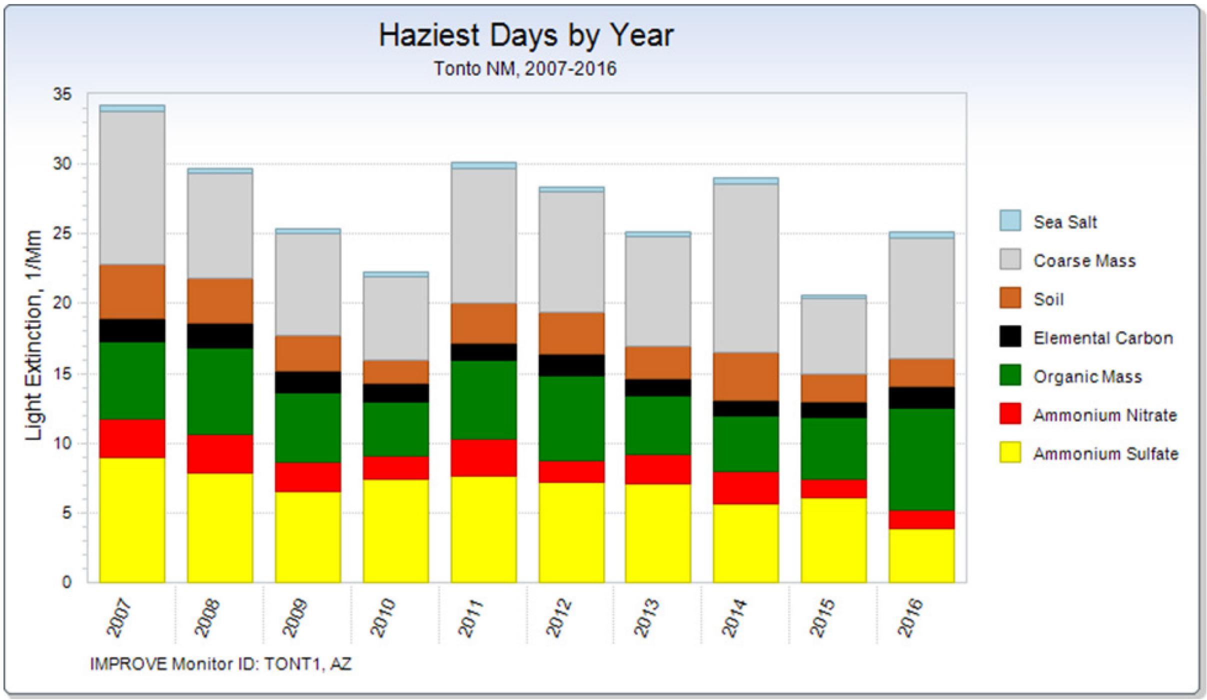

Figure 5. Composition of visibility-degrading aerosols for haziest days at Tonto National Monument

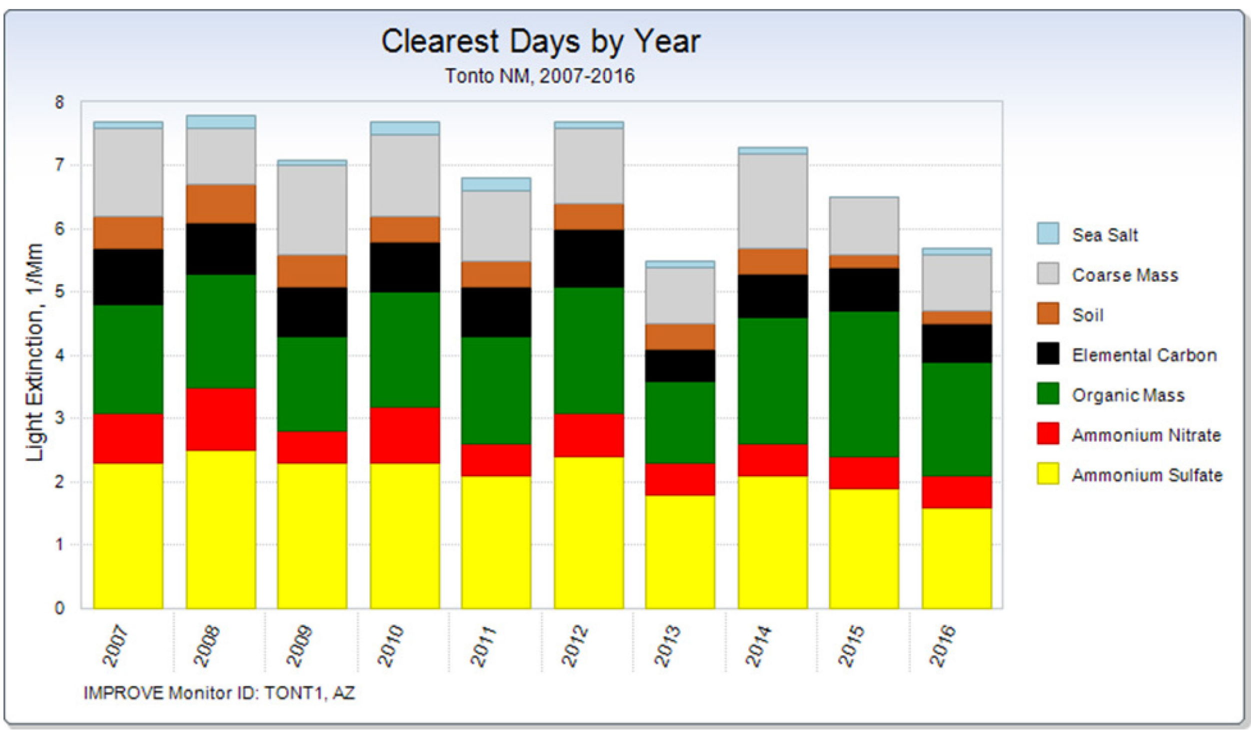

Figure 6. Composition of visibility-degrading aerosols for cleanest days at Tonto National Monument

None of Arizona's Class I areas, including the four within the Tonto National Forest, are projected to meet the Uniform Rate of Progress for visibility by 2018; however, all have visibility that has improved since the baseline period of 2000 through 2004. Many of the air pollutants that affect Arizona originate from sources outside Arizona, such as Mexico and surrounding states, and are caused by a combination of anthropogenic sources, natural sources, and long-distance transport. The State has a list of strategies[24] (long-term strategy) to address regional haze visibility impairment in each Class I area in Arizona.

Outside Sources

Emissions of air pollutants from outside the Tonto National Forest come from urban Phoenix, nearby copper mining and smelting, motor vehicles, and regional haze. Visibility, as measured at the three sites discussed below, has improved somewhat since the baseline period of 2000 through 2004. Nonetheless, additional improvement would have to amount to a 50 percent reduction in light extinction to meet the long-term visibility goals of 2064.

Several components of air pollution can affect vegetation, but ozone generally results in the greatest amount of damage. Visible effects on leaves or needles can include stipple (dark colored lesions resulting from pigmentation of injured cells), fleck (tiny light-colored lesions on the upper layers of the leaf), mottle (degeneration of the chlorophyll that cause a blotchy appearance), necrosis (death of tissue), and in extreme cases, mortality. Ozone exposure can also decrease plant growth rates. Ponderosa pine is recognized as an ozone-sensitive species.

Acidity in rain, snow, fog, and dry deposition can affect soil fertility and nutrient cycling and can result in acidification of lakes and streams. Sulfate deposition to sensitive watersheds results in increasing soil acidification and surface water acidification. Deposition of excess nitrogen (nitrate and ammonium) in both terrestrial and aquatic systems can acidify streams, lakes, and soils.

Aquatic ecosystems in Arizona are generally well buffered and not subject to episodic or chronic acidification (Blankenship 1991). Although little research has been done on the effects of urban Phoenix's emissions on the six reservoirs within the Tonto National Forest, daytime prevailing winds come from the west and southwest, transporting the urban plume into the Verde and Salt River watersheds. The United States Geological Survey and the Arizona Department of Environmental Quality both make periodic measurements of stream flow and of the microbiology and chemistry of these waters. While sulfates and nitrates are most definitely being deposited throughout the forest and its reservoirs, their effects on water quality, soil quality, and the biota of the ecosystems remain mostly unstudied and unquantified.

Motor Vehicles

Tailpipe emissions from motor vehicles should be considered important in relation to many of the lands within the Tonto National Forest. Dispersion and air mixing reduces most impacts within a short distance, especially during the better ventilation of daytime hours. At night and in the three hours after sunrise, however, this mixing is often suppressed by a nocturnal temperature inversion. This is a surface-layer atmospheric phenomenon that occurs whenever the night-time skies are cloudless (or nearly so) and in the absence of storm fronts. A layer of colder air next to the ground is "trapped" by a warmer layer above it; so vertical ventilation is severely suppressed. Major highways such as US Highway 60, whose traffic takes place within 10 to 12 miles of the Superstition Wilderness Area, and Arizona State Highway 87, which is routed at similar distances from the Four Peaks, Mazatzal, and Hellsgate Wilderness Areas,

[24] For further information on the long-term strategy, refer to the State Implementation Plan at https://www.azdeq.gov/SIP.

produce vehicular emissions which adversely affect the health of the nearby grasslands, shrublands, and forested lands.

Regional Haze

Parts of the Tonto National Forest fall within the Phoenix nonattainment area for ozone and within the maintenance area for particulates 10 microns and smaller (PM_{10}). According to State of Arizona regulations, this requires complex modeling of emissions and their resultant concentrations for major air pollution sources. Minor projects and activities do not require these analyses, although they still have to obtain the requisite dust control and stormwater runoff permits. Prescribed fire does have both local and regional significance; but modeling and projections are usually not conducted for prescribed fire projects. Instead, prescribed fire smoke is managed through cooperation between the foresters and the Arizona Department of Environmental Quality, discussed in detail in the section on fire in the Cumulative Effects section of this report.

Regional haze causes visibility impairment and has been documented in all Class I airsheds in Arizona and New Mexico. In the Intermountain West, nitrates, sulfate, organic carbon, and elemental carbon are the main causes of visibility impairment. Sources of regional haze contributing to the four Class I airsheds of the Tonto National Forest also include dust and smoke in the form of particulate matter (PM).

In the 1990 amendments to the Clean Air Act, Congress established the requirements to address regional haze. They gave Environmental Protection Agency the authority to establish visibility transport commissions and promulgated regulations to address regional haze. The 1990 amendments also established a specific visibility transport commission (Grand Canyon Visibility Transport Commission or GCVTC) to investigate and report on regional haze and visibility impairment in Grand Canyon National Park and nearby Class I areas. This assessment (GCVTC 1996) indicated that road dust is a large contributor to visibility impairment on the Colorado Plateau, which includes the northern half of Arizona. Road dust is generated on the forests as well as off the forests on private, State, and Tribal lands. Most of the secondary roads on the Colorado Plateau are not paved and contribute to visibility impairment. While the Tonto National Forest lies almost entirely below the Mogollon Rim and the Colorado Plateau, these dirt-road emissions can be transported into forest lands whenever winds blow from the north.

Smoke is also a contributor to regional haze. The State has developed statutes for the management of smoke within each smoke management zone (airshed) and regulates smoke from prescribed fires. Smoke management zones include multiple jurisdictions and landowners. This coordination results in mitigation of the cumulative effects of smoke from burning activities.

Air Pollution from within the Tonto National Forest

Tonto National Forest management activities contribute to the emissions of the six regulated pollutants identified by the Environmental Protection Agency, especially for particulate matter. The primary sources of particulate matter from the forest come from road and fugitive dust and emissions from smoke, contributing to regional haze. Motor vehicle use on the forests also contributes vehicular emissions. Emissions from recreational boats can be noticeable during hot summer days too.

Dust generated from vehicles driving on unpaved National Forest System roads can contribute to regional haze. There is no direct relationship between miles of roads on the forests and actual miles traveled by motor vehicles. This is more a function of peak usage times such as during summer holidays when the forests get high use. During winter, the same roads generate almost no usage by vehicles. Additionally, PM_{10} generated from unpaved roads, generally settles out within 100 yards of the dirt road but the smaller

$PM_{2.5}$ particles can remain airborne for hours and days. Unpaved road particulates most definitely contribute to airborne concentrations and reduce visibility.

Environmental Effects[25]

Effects Common to All Alternatives

Emissions from Wildfire

Smoke production is an unavoidable part of planned ignitions (prescribed burns); nonetheless, strategies to limit smoke impacts are required in every prescribed fire plan. Because meteorological and environmental conditions vary (e.g., ventilation, wind direction, mixing height), the number of acres burned on any given day would also vary. Meteorological and environmental conditions each year may also affect the annual total number of acres treated. Projects will be designed in a way to lessen the impacts produced by smoke emissions. The prescribed fire burn plan may include such strategies as burning with wind directions and other atmospheric conditions that allow smoke to adequately ventilate or be transported away from communities. The burn plan may also stipulate management practices which would mitigate smoke production. For example, managers can choose ignition sequences and patterns, avoid lighting heavy fuels, notify the affected communities, and use other management practices that would either limit smoke production or, when feasible, direct the smoke away from populated areas. Arizona Department of Environmental Quality reviews daily burn requests and may limit the number of acres burned to reduce smoke impacts.

Impacts on air quality from wildfires may be highly variable. Smoke management for wildfires includes notifying the Arizona Department of Environmental Quality based on fire size and location and assessing potential fire behavior and smoke. If smoke impacts occur, overall fire management strategies may be adjusted in order to mitigate smoke to sensitive individuals, communities, and visibility.

Dust Generated from Grazing Activities

Under all alternatives, grazing management use of the transportation system is limited and effects on air quality from this activity, while perhaps not measurable, would still constitute a contributor to degraded air quality. Fugitive dust is generated in areas with the highest livestock concentrations or from vehicles accessing allotments to conduct livestock management. Best management practices should be effective in retaining protective ground cover, reducing exposed soil susceptible to wind erosion, and reducing the amounts of fugitive dust.

Dust Generated from Special Uses

Under all alternatives, road use associated with mineral materials or energy development will require dust abatement measures. Implementation of dust abatement measures would reduce or eliminate impacts to air quality. Effects of dust would be analyzed prior to issuance of each special use permit.

Dust Generated from Mechanical Treatments

The soils of the forests' undisturbed ecosystems resist wind through plant or litter cover, as well as naturally occurring crusts known as macrobiotic soil crusts. Soil crusts are indeed fragile; however, they resist wind and help prevent dust particles from becoming airborne. When the crust is broken through mechanical activities or disturbance such as grazing, small particles can get into the air during the activity or later during high wind events. Under all alternatives, all land-disturbing activities, including wildland

[25] All assumptions and methods used for this analysis can be found in volume 4 of the environmental impact statement, appendix B.

fire, would include site-specific best management practices or soil and water conservation practices[26] that prescribe measures to reduce or mitigate formation of fugitive dust either by preventing loss of protective ground cover or by requiring its reestablishment.

Road dust and dust generated from motorized equipment would be largely dependent upon the season of use, the amount of traffic, rainfall patterns, and materials selected for road construction. Most of this dust generally settles quickly, especially the particles larger than 10 microns, but particles smaller than 10 microns, and especially those smaller than 2.5 microns, can be transported considerable distances. These particulates can become fugitive dust where conditions are typically dry and/or where roads are constructed from fine-grained materials and do not have a paved or gravel surface. Dust mitigation (e.g., road watering, surfacing, chemical treatment) may occur in high traffic areas to improve road visibility and where activities are close to private land or large campgrounds to prevent impacts to human health.

The vegetation nearest the road can become heavily coated with dust, but with increasing distance from the road, these particles diminish to the point of invisibility. Additional and important environmental effects also occur from these emissions. The respiratory health of recreationists, if they are close to the dust emission areas, is compromised by PM_{10}; furthermore, those recreationists at considerable distances from the unpaved road traffic (or other dust source) are subject to elevated $PM_{2.5}$. These finer particles present a respiratory threat to human health considerably greater than the larger PM_{10} particles. Another consequence of these dust-producing activities is the nuisance of dust coating vehicles and camping equipment. A more widespread ecological result is that the dust on the foliage and ground surface is itself further transported by either wind or water or both, resulting in these geological particles entering the streambed and eventually the receiving water bodies. This secondary transport can produce high levels of turbidity in the streams, rivers, and lakes. For $PM_{2.5}$ the longer transport times and distances produce more distant effects, namely (1) a reduction of visibility within the forest and nearby airsheds and (2) their eventual deposition onto the land surface and its water bodies. As with their larger counterparts, $PM_{2.5}$ particles thus deposited contribute to increased turbidity in the water bodies and, depending on their chemical composition, can contribute to the amount of total dissolved solids in the waters. Looking at this matter from a human health perspective, however, the finer particles of $PM_{2.5}$ cause much more respiratory distress than do the larger size fraction of PM_{10}.

Dust Generated from Recreation Activities

Recreational use of the transportation system can vary in intensity during late spring/early summer and late fall months, when dust can be problematic. Recreation use can occur on any open road. One of the most popular recreation uses on the forests is driving for pleasure (English et al. 2004). Dust abatement measures are generally not applied on most system roads due to budget limitations and may also occur on non-Forest Service System roads. Dust generated from recreation activities may increase in the long term as the general population increases in all alternatives.

Effects to Nonattainment Areas

The nonattainment areas in question here are three: in and around Hayden (copper mining and smelting), Globe-Miami (copper mining and smelting), and urban Phoenix (all activities producing pollutants, but especially vehicular transportation and large-scale construction projects that involve earth moving). The pollutants of concern are particulate matter, sulfur dioxide, and lead for Hayden; particulate matter and sulfur dioxide for Globe-Miami; and particulate matter and ozone for urban Phoenix. Furthermore, for the Phoenix area, emissions of nitrogen oxides and hydrocarbons, the two precursors of ozone, have considerable effects on the forest, because they are transported to the southwest corner of the forest.

[26] Forest Service Handbook 2509.23 R3

During transport, these gaseous pollutants are converted to particulate nitrates and secondary organic aerosols (carbon), which degrade visibility and are deposited to the ground surface. The Hayden nonattainment area lies some 20 miles southeast of the nearest Tonto National Forest holdings. This distance is sufficient that pollutants generated within the forest would be most unlikely to adversely affect the air quality in Hayden and Winkelman. The Globe-Miami nonattainment area is a different matter altogether, as substantial acreages of the Tonto National Forest are being actively mined (mostly for copper) and other parts of the forest lie within this nonattainment area. A similar situation pertains to the urban Phoenix nonattainment area, as the southwestern most portions of the Tonto National Forest lie within the nonattainment areas for both ozone and particulate matter. The question is whether any one (or more) of the management alternatives would have a substantially greater effect on the air quality of these nonattainment areas.

First, consider the Globe-Miami nonattainment area. Within the Tonto National Forest there are virtually zero emissions of sulfur dioxide, so any forest activities would not add to the sulfur dioxide concentrations of the nonattainment area. That leaves particulate matter, PM_{10}, particles 10 microns and smaller (a human hair has a diameter of about 40 microns). Air pollution monitoring for particulates has been conducted for decades at two sites in Miami, one called the Golf Course, the other, Ridgeline (Arizona Department of Environmental Quality 2009). Both monitoring sites have recorded PM_{10} concentrations well within the air quality standards. For example, in recent years the annual averages have ranged from 12 to 23 micrograms per cubic meter ($\mu g/m^3$), well within the standard value of 50 $\mu g/m^3$. It should be noted that the Environmental Protection Agency rescinded the annual standard for PM_{10} in 2006 for lack of evidence of health effects; yet this former standard still serves as a reasonable annual benchmark. The 24-hour average PM_{10} standard remains in effect; its value is 150 $\mu g/m^3$. The two Miami monitoring sites have recorded maximum and second-highest concentrations in the range of 30 to 50 $\mu g/m^3$, roughly one fifth to one third of the standard value. It is most unlikely that any activities within the Tonto National Forest, be they prescribed fire, wildfire, traffic on dirt roads, campfires, and so forth – within any of the alternatives – would produce enough particulate emissions to contribute to a violation of the standards at these two Miami monitoring sites.

Second, consider the Maricopa County nonattainment area for ozone and PM_{10}, a small part of which includes the southwestern most lands of the Tonto National Forest. What is the likelihood that activities within the forest could affect the particulate or ozone air quality within the nonattainment area? That likelihood is generally extremely low, for the simple reason that the emission totals within the nonattainment area are immensely larger than any emissions produced within the forest. Although no emissions inventory is available for the Tonto National Forest, the combined activities of urban Phoenix's 4.5 million residents most certainly would dwarf those emissions produced by activities within the forest. Therefore, normal forest activities among the various alternatives cannot materially affect the air quality of the urban Phoenix region. The exception here is wildland fire, whose smoke certainly can and has affected the Phoenix concentrations of fine particles and ozone, as evidenced in 2021 by the smoke intrusion from the Telegraph Fire.

Alternative A Effects

Alternative A, the Forest's 1985 plan, effectively the written status quo for forest management, can be regarded as a baseline for evaluating the other alternatives. Present-day air quality and visibility conditions are a consequence of this baseline alternative.

Emissions from Wildfire

Problem or nuisance smoke from wildfire (including prescribed fire) is defined by the Environmental Protection Agency as the amount of smoke in the ambient air that interferes with a right or privilege common to members of the public, including the use or enjoyment of public or private resources. While no laws or regulations govern nuisance smoke, it effectively limits opportunities of land managers to use fire. Public outcry regarding nuisance smoke often occurs long before smoke exposures reach levels that violate National Ambient Air Quality Standards (Achtemeir et al. 2001). Furthermore, because the only National Ambient Air Quality Standards for particulates are expressed as either 24-hour or annual averages, short-term exposures do not come under the purview of the standards. Instead, there are various guidelines for these shorter-term exposures, including one from a consortium of government agencies and several from independent researchers (Environmental Protection Agency et al. 2016 and Reid 2016). This document provides information on how to use visual range (also known as visibility) to estimate smoke exposure and to inform the affected publics. Public tolerance of smoke, however, sets the social limit on the number of acres burned and smoke produced from prescribed fires. The level of acceptance varies from year to year and from community to community. Smoke may impact nursing homes, hospitals, and other populations sensitive to temporary air pollution. Smoke can also impact other areas such as local communities, transportation corridors, and highly valued scenic vistas. Smoke effects described in the affected environment are anticipated to remain constant, as there would be no change in the current rate of treatment for wildfire under alternative A.

Dust Generated from Mechanical Treatments

Road dust and dust generated from motorized equipment would be largely dependent upon the season of use, the amount of traffic, rainfall patterns, and materials selected for road construction. Most of this dust generally settles quickly, especially the particles larger than 10 microns, but particles smaller than 10 microns, and especially those smaller than 2.5 microns, can be transported considerable distances. These particulates can become fugitive dust where conditions are typically dry and/or where roads are constructed from fine-grained materials and do not have a paved or gravel surface. Dust mitigation (e.g., road watering, surfacing, chemical treatment) may occur in high traffic areas to improve road visibility and where activities are close to private land or large campgrounds to prevent impacts to human health. Based on current treatments levels, dust generated from mechanical treatments would be low compared to alternative B and D due to fewer acres treated.

Dust Generated from Recreation Activities

Recreational use of the transportation system can vary in intensity during late spring/early summer and late fall months, when dust can be problematic. Recreation use can occur on any open road. One of the most popular recreation uses on the forests is driving for pleasure (English et al. 2004). Dust abatement measures are generally not applied on most system roads due to budget limitations and may also occur on non-National Forest System roads. Dust generated from recreation activities may increase in the long term as the general population increases in all alternatives. However, alternative D emphasizes motorized recreation opportunities more than the other alternatives; consequently, it would result in the highest level of dust generated from recreation activities.

Dust Generated from Grazing Activities

Fugitive dust is generated in areas with the highest livestock concentrations or from vehicles accessing allotments to conduct livestock management. Best management practices should be effective in retaining protective ground cover, reducing exposed soil susceptible to wind erosion, and reducing the amounts of fugitive dust. Alternative C would have the least amount of grazing; alternative D would have the most, while alternatives A and B would be in between. Therefore, negative effects are anticipated to be moderate under alternative A.

Alternative B Effects

Alternative B is considered a proposed adaptive management strategy that responds to all the conditions that have changed over the past 33 years, including the landscapes of the forest themselves and the consensus of public opinions. This alternative calls for 43,204 acres of recommended new wilderness areas, for four new botanical areas, and for four new research natural areas. This alternative does not call for additional enhanced smoke management, does not call for additional visibility monitoring, and does not call for additional prescribed fire and wildland fire management techniques. All of these activities are already being accomplished. Therefore, as with alternative A, alternative B would be expected to mostly continue present-day air quality and visibility conditions.

Emissions from Wildfire

Smoke from wildfire may impact nursing homes, hospitals, and other populations sensitive to temporary air pollution. Smoke can also impact other areas such as local communities, transportation corridors, and highly valued scenic vistas. Alternative B would have similar effects to alternative A. Alternative B would produce the same amount of fire emissions as are being emitted in the present time frame. For example, in this alternative, over a 10-year period, considering the Tonto National Forest as a single entity, there would be 50,000 to 122,000 acres treated with a combination of mechanical thinning and wildland fire. The wildland fire would include 22 percent of the acreage treated by prescribed burns. In addition, considering just wildland fire (with its 22 percent from prescribed burns), this alternative calls for treating from 105,000 to 325,000 acres.

Dust Generated from Mechanical Treatments

The soils of the forests' undisturbed ecosystems resist wind through plant or litter cover, as well as naturally occurring crusts known as macrobiotic soil crusts. Soil crusts are indeed fragile; however, they resist wind and help prevent dust particles from becoming airborne. When the crust is broken through mechanical activities or disturbance such as grazing, small particles can get into the air during the activity or later during high wind events. Negative effects from dust generated from mechanical treatments would be higher than alternatives A and C, but lower than alternative D.

Road dust and dust generated from motorized equipment would be largely dependent upon the season of use, the amount of traffic, rainfall patterns, and materials selected for road construction. Most of this dust generally settles quickly, especially the particles larger than 10 microns, but particles smaller than 10 microns, and especially those smaller than 2.5 microns, can be transported considerable distances. These particulates can become fugitive dust where conditions are typically dry and/or where roads are constructed from fine-grained materials and do not have a paved or gravel surface. Dust mitigation (e.g., road watering, surfacing, chemical treatment) may occur in high traffic areas to improve road visibility and where activities are close to private land or large campgrounds to prevent impacts to human health.

Dust Generated from Recreation Activities

Recreational use of the transportation system can vary in intensity during late spring/early summer and late fall months, when dust can be problematic. Recreation use can occur on any open road. One of the most popular recreation uses on the forests is driving for pleasure (Kocis et al. 2002). Dust abatement measures are generally not applied on most system roads due to budget limitations and may also occur on non-National Forest System roads. Dust generated from recreation activities may increase in the long term as the general population increases in all alternatives. However, alternative D emphasizes motorized recreation opportunities more than the other alternatives; consequently, it would result in the highest level of dust generated from recreation activities.

Dust Generated from Grazing Activities

Fugitive dust is generated in areas with the highest livestock concentrations or from vehicles accessing allotments to conduct livestock management. Best management practices should be effective in retaining protective ground cover, reducing exposed soil susceptible to wind erosion, and reducing the amounts of fugitive dust. Effects are the same as alternative A.

Alternative C Effects

Alternative C contains the same proposed botanical and research natural areas as alternative B but would increase the recommended wilderness acreage by eight-fold to some 369,000 acres. This alternative consists of the same management strategies as alternative B, with regard to prescribed and wildland fire management and other activities that produce air pollutants. Where the alternative differs is that it calls for more nonmotorized and primitive recreation, for additional protection of riparian areas from timber and grazing, for more restrictions on land use in general, and for fewer opportunities for economic contributions from local economies. Plan components included in this alternative would reduce negative effects of air pollutant emissions within the forest. Reduced off highway vehicle miles traveled, reduced grazing, and reduced timber harvesting translate directly into reduced air pollutant emissions. Expansion of recommended wilderness areas by eight times over alternative B simply means that all the various human activities now taking place in these areas, whether it be off-road, motorized vehicle use, jet skis use, grazing of cattle, or harvesting of timber, will be drastically reduced. Reduced human activities that cause air pollution lead to cleaner air.

Emissions from Wildfire

Smoke from wildfire may impact nursing homes, hospitals, and other populations sensitive to temporary air pollution. Smoke can also impact other areas such as local communities, transportation corridors, and highly valued scenic vistas. Alternative C calls for expanded wilderness areas and does call for major changes in the use of prescribed fire or mechanical thinning. For example, alternative C calls for much less mechanical thinning combined with wildland fire than alternative B – 11,000 to 22,000 acres. In contrast, this alternative calls for more acreage to be treated by wildland fire alone – 144,000 to 4423,000 acres. Therefore, this alternative would produce considerably more smoke than alternative B.

Dust Generated from Mechanical Treatments

The soils of the forests' undisturbed ecosystems resist wind through plant or litter cover, as well as naturally occurring crusts known as macrobiotic soil crusts. Soil crusts are indeed fragile; however, they resist wind and help prevent dust particles from becoming airborne. When the crust is broken through mechanical activities or disturbance such as grazing, small particles can get into the air during the activity or later during high wind events. Negative effects from dust generated from mechanical treatments would be lowest under alternative C.

Road dust and dust generated from motorized equipment would be largely dependent upon the season of use, the amount of traffic, rainfall patterns, and materials selected for road construction. Most of this dust generally settles quickly, especially the particles larger than 10 microns, but particles smaller than 10 microns, and especially those smaller than 2.5 microns, can be transported considerable distances. These particulates can become fugitive dust where conditions are typically dry and/or where roads are constructed from fine-grained materials and do not have a paved or gravel surface. Dust mitigation (e.g., road watering, surfacing, chemical treatment) may occur in high traffic areas to improve road visibility and where activities are close to private land or large campgrounds to prevent impacts to human health.

Dust Generated from Recreation Activities

Recreational use of the transportation system can vary in intensity during late spring/early summer and late fall months, when dust can be problematic. Recreation use can occur on any open road. One of the most popular recreation uses on the forests is driving for pleasure (Kocis et al. 2002). Dust abatement measures are generally not applied on most system roads due to budget limitations and may also occur on non-National Forest System roads. Dust generated from recreation activities may increase in the long term as the general population increases in all alternatives. There would likely be lower effects of dust from recreation activities, as there is a potential for an increase in decommissioning of motorized trails.

Dust Generated from Grazing Activities

Fugitive dust is generated in areas with the highest livestock concentrations or from vehicles accessing allotments to conduct livestock management. Best management practices should be effective in retaining protective ground cover, reducing exposed soil susceptible to wind erosion, and reducing the amounts of fugitive dust. Alternative C would have the least amount of grazing; alternative D would have the most, while alternative B would be in between. Therefore, effects of dust from grazing would be the lowest under alternative C.

Alternative D Effects

There are no recommended wilderness areas and no botanical or research natural areas under alternative D. This alternative calls for more motorized or accessible recreation, more management-heavy restoration projects (more timber harvesting), fewer restrictions on land uses, continued grazing throughout the forest, more adaptable rangeland management practices, and more opportunities for economic contribution to local communities. Each and every one of these proposed activities leads to more disturbances of the ecosystems. Each and every one generates additional air pollutant emissions above the other alternatives, whether through dust or combustion from vehicles and equipment (e.g., chain saws). Following this alternative would lead to the greatest mass of emissions within the forest and therefore the worst air quality of the four alternatives.

There would be continued use of forest roads by motor vehicles, which is expected to increase over the next 15 years. Use of motor vehicles on unpaved roads would also increase over the existing condition. This would result in the generation of dust, which is expected to contribute to visibility impairment but would contribute at least marginally to the eight Class I air sheds. Any proposed forest management activities that would contribute dust would adhere to air quality standards as set by Environmental Protection Agency and Arizona Department of Environmental Quality and the effects would be mitigated at the project-level.

Emissions from Wildfire

Smoke from wildfire may impact nursing homes, hospitals, and other populations sensitive to temporary air pollution. Smoke can also impact other areas such as local communities, transportation corridors, and highly valued scenic vistas. Alternative D calls for the most acreage to be treated by the combination of mechanical thinning and prescribed fire – 50,000 to 190,000 acres. But in contrast to the other alternatives, it calls for a much smaller acreage to be treated by wildland fire alone, 16,000 to 62,000 acres. Hence, alternative D would produce the least amount of fire smoke of the four. This is the case because emissions from wildland fires, even with 22 percent of the acreage being treated with prescribed fires, dominate the emissions landscape. Alternative D has by far the lowest acreage for wildland fire alone, but that it has the largest potential acreage for mechanical thinning with wildland fire, provided that the 190,000 acre is actually reached. Alternative C minimizes the area of mechanical thinning with wildland fire.

Dust Generated from Mechanical Treatments

The soils of the forests' undisturbed ecosystems resist wind through plant or litter cover, as well as naturally occurring crusts known as macrobiotic soil crusts. Soil crusts are indeed fragile; however, they resist wind and help prevent dust particles from becoming airborne. When the crust is broken through mechanical activities or disturbance such as grazing, small particles can get into the air during the activity or later during high wind events. Dust generated from mechanical treatments would be greatest under alternative D, which proposes the highest amount of mechanical treatment and associated road use.

Road dust and dust generated from motorized equipment would be largely dependent upon the season of use, the amount of traffic, rainfall patterns, and materials selected for road construction. Most of this dust generally settles quickly, especially the particles larger than 10 microns, but particles smaller than 10 microns, and especially those smaller than 2.5 microns, can be transported considerable distances. These particulates can become fugitive dust where conditions are typically dry and/or where roads are constructed from fine-grained materials and do not have a paved or gravel surface. Dust mitigation (e.g., road watering, surfacing, chemical treatment) may occur in high traffic areas to improve road visibility and where activities are close to private land or large campgrounds to prevent impacts to human health.

Dust Generated from Recreation Activities

Recreational use of the transportation system can vary in intensity during late spring/early summer and late fall months, when dust can be problematic. Recreation use can occur on any open road. One of the most popular recreation uses on the forests is driving for pleasure (Kocis et al. 2002). Dust abatement measures are generally not applied on most system roads due to budget limitations and may also occur on non-National Forest System roads. Dust generated from recreation activities may increase in the long term as the general population increases in all alternatives. However, alternative D emphasizes motorized recreation opportunities more than the other alternatives; consequently, it would result in the highest level of dust generated from recreation activities.

Dust Generated from Grazing Activities

Fugitive dust is generated in areas with the highest livestock concentrations or from vehicles accessing allotments to conduct livestock management. Best management practices should be effective in retaining protective ground cover, reducing exposed soil susceptible to wind erosion, and reducing the amounts of fugitive dust. Grazing levels have the potential to be the highest under alternative D, therefore the associated negative impacts would be highest under this alternative.

Cumulative Effects

This cumulative effects analysis does not attempt to quantify the effects of past actions by adding up all prior actions on an action-by-action basis. To understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current conditions (as detailed in the description of alternative A) as a proxy for the impacts of past and present actions. This is because existing conditions reflect the aggregate impact of all prior actions and natural events. This analysis focuses on the cumulative impact of those reasonably foreseeable actions that are relevant in assessing the impacts of revising the forest plan. In terms of reasonably foreseeable future actions, this analysis has attempted to include, specific to air quality resources, projects for which upcoming actions are known and can be meaningfully analyzed. What will not be analyzed are projects that are inevitable and known, but which have not yet developed proposed actions.

To some extent neighboring lands to the Tonto National Forest produce air pollutant emissions that affect the air quality of the Tonto National Forest; and, conversely, the Tonto National Forest produces emissions that do or can affect all of its neighbors. Naturally, the closer the neighbor to the forest, the greater effects its emissions can have. Not all of these neighboring lands will be discussed in this section, but a few require discussion.

First, and probably most important, is the Phoenix area, which, given in tons per day, produces some 858 tons of hydrocarbons, 173 tons of nitrogen oxides, 111 tons of PM_{10}, 34 tons of $PM_{2.5}$, 1,180 tons of carbon monoxide, 3 tons of sulfur oxides, and 24 tons of ammonia (Maricopa County Air Quality District 2019a and b). Prevailing daytime winds come from the west and southwest, transporting these pollutants directly into the Tonto National Forest. Ground-level ozone concentrations formed by photochemical reactions from hydrocarbons and oxides of nitrogen, also is transported into the forest. Of equal importance, the urban Phoenix population accounts for much of the recreational usage hours on the forest.

Second, consider the three active copper mining properties (the Resolution Copper Mine has been proposed but has not been built). The Pinto Valley Mine has property adjacent to and surrounded by the Tonto National Forest, and some of its dumps and tailings piles are on forest lands. Groundwater down-gradient of the leaching facilities flows directly into the Pinto Creek watershed. Windblown tailings, especially on abandoned tailings piles, are transported directly into the forest. The Carlotta Copper Mine is also in the Pinto Creek watershed, is adjacent to the Pinto Valley Mine, and produces 23.3 million pounds of copper annually. As with the Pinto Valley Mine, the Carlotta facility has the potential to contaminate the ground water within the watershed. As for the copper smelter in Miami, Arizona, its emissions are substantial (in tons per year): PM_{10}, 310; $PM_{2.5}$, 196; SO_2, 644; NOx, 265; hydrocarbons, 198; and sulfuric acid, 127. Tonto National Forest lands surround this facility and the town of Miami, so the forest is necessarily a receptor for much of the air pollution.

Third, consider the various forested lands adjacent to or near the Tonto National Forest: two large Indian communities and four national forests. All of these entities face similar difficulties in harvesting the timber and in maintaining the healthy ecology of the forests. All conduct prescribed burns; some are actively engaged in mechanical thinning. Dust and smoke from these activities can be, have been, and will be transported into the Tonto National Forest. Likewise, those activities on the Tonto National Forest affect these neighboring forested areas.

Forests are dynamic systems that naturally undergo ebbs and flows in carbon storage and emissions as trees establish and grow, die with age or disturbances, and re-establish and regrow. Through photosynthesis, growing plants remove CO_2 from the atmosphere and store it in forest biomass, such as in plant stems, branches, foliage, and roots. Some of this organic material is eventually stored in forest soils through biotic and abiotic processes (Ryan et al. 2010). Carbon can also be transferred and stored outside of the forest ecosystem in the form of wood products, further influencing the amount of carbon entering the atmosphere (Gustavvson et al. 2006, Skog et al. 2014). Many management activities initially remove carbon from the forest ecosystem, but they can also result in long-term maintenance or increases in forest carbon uptake and storage by improving forest health and resilience to various types of stressors (McKinley et al. 2011). Under all Alternatives, the amount of carbon that might be removed is small relative to the approximately 34.9 million tons of carbon stored in the vegetation on the Tonto National Forest (USDA Forest Service 2017a). Climate change is likely to affect air quality on the Tonto National Forest equally across all alternatives.

Management Areas

The Tonto National Forest has management areas that contain special, exceptional, or unique values that provide important ecosystem services. These management areas contribute to social sustainability by connecting people to their natural and cultural heritage and providing economic benefits to surrounding communities. Management areas promote the preservation of cultural traditions including historical features that contribute to social wellbeing through education and provide recreational opportunities. Economic sustainability is supported by increased employment opportunities, supporting small businesses, and sharing Federal receipts with county and state governments. Management areas contribute to ecological sustainability as well, by preserving intact natural systems and their individual components. The management areas on the Tonto National Forest can be split into two distinct groups: Those that have been congressionally or administratively designated, and those that are recommended or proposed within the forest plan. Descriptions of these areas can be found in the revised forest plan.

Some of these areas meet the criteria to be considered special places and become designated areas: an area or feature identified and managed to maintain its unique special character or purpose. Designated areas may be statutorily designated by Congress or administratively designated by authorities such as the Secretary of Agriculture, Forest Service Chief, regional forester, or responsible official. Once established, the designation continues until a subsequent decision by the appropriate authority removes the designation. Management areas that have been congressionally or administratively designated include:

- Designated wilderness
- Designated wild and scenic rivers
- Designated research natural areas
- Inventoried roadless areas
- National trails
- Significant Caves
- Apache Leap Special Management Area
- Saguaro Wild Burro Management Area

The revised forest plan also includes proposed areas that are managed for specific characteristics or features but may need to be established through a separate process. These areas exist for the protection and public enjoyment of areas of special characteristics. Areas recommended or proposed in forest plans may change through the life of the plan. Management areas that have been recommended or proposed within the revised forest plan include:

- Recommended Wilderness Areas
- Eligible Wild and Scenic Rivers
- Proposed Research Natural Areas
- Proposed Botanical Areas
- Lakes and Rivers Management Area
- Salt River Horse Management Area

The presence and extent of each recommended or proposed management area may vary by alternative (table 201).

Table 201. Recommended or proposed management areas by alternative

Drivers and Areas	Alternative A	Alternative B	Alternative C	Alternative D
Recommended Wilderness	None	About 43,204 acres	About 399,029 acres	None
Eligible Wild and Scenic Rivers	19 eligible Wild and Scenic Rivers	19 eligible Wild and Scenic Rivers	19 eligible Wild and Scenic Rivers	19 eligible Wild and Scenic Rivers
Proposed Botanical Areas	None	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	Fossil Springs, Little Green Valley Fen, Horseshoe, Mesquite Wash	None
Proposed Research Natural Areas	Picketpost Mountain, Upper Forks Parker Creek	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	Dutchwoman Butte, Picketpost Mountain, Three Bar, Upper Forks Parker Creek	None
Management Areas	Blue Point Cottonwood, Fossil Springs Natural Area, Sycamore Creek Natural Area, Three Bar Wildlife Area.	Lakes and Rivers Management Area, Salt River Horse Management Area	Salt River Horse Management Area	Lakes and Rivers Management Area, Salt River Horse Management Area

Summary of Management Areas by Alternative

The following table identifies the management areas' presence or absence in each alternative and summarizes purpose of management direction specific to the management areas. The effect of the presence or absence of management areas for other resources is described in the other resource sections of this final environmental impact statement.

Table 202. Summary of presence or absence of management areas and associated direction by alternative

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
Designated Wilderness	Condition of wilderness character may decline with inconsistent management of wilderness areas across the forest, including impacts (e.g., loss of solitude) to the wilderness character identified in each of the wilderness areas	Condition of wilderness character may improve with consistent plan direction focused on wilderness stewardship. Management direction for designated wilderness would allow for increased protections and enhancement of wilderness character across the forest.	Condition of wilderness character may improve with consistent plan direction focused on wilderness stewardship. Management direction for designated wilderness would allow for increased protections and enhancement of wilderness character across the forest. With increased emphasis of natural forces and focus on primitive recreation in this alternative, there could be enhancement of unconfined recreation opportunities through prioritization of projects on the forest related to primitive recreation.	Though there is specific plan direction focused on wilderness stewardship, the condition of wilderness character may decline based on emphasis of development and increase in non-conforming uses outside of wilderness boundaries. This could lead to more access around the perimeter of wilderness areas, and increased encroachment by non-primitive recreation types.
Recommended Wilderness	None exist in this alternative. Could lead to a decrease in wilderness characteristics (e.g., solitude, unconfined recreation, apparent naturalness) in areas where these qualities have been identified but don't have additional management direction specifically to preserve them.	43,204 acres proposed; management of these areas would assure the protection of wilderness characteristics identified through the Wilderness Recommendation Process including opportunities for solitude, unconfined recreation, apparent naturalness, and other identified unique qualities in the proposed areas.	399,029 acres proposed; management of these areas would assure the protection of wilderness characteristics identified through the Wilderness Recommendation Process including opportunities for solitude, unconfined recreation, apparent naturalness, and other identified unique qualities in the proposed areas. This alternative has the highest potential for condition of wilderness characteristics to	None exist in this alternative. Could lead to a decrease in wilderness characteristics (e.g., solitude, unconfined recreation, apparent naturalness) in areas where these qualities have been identified but don't have additional management direction specifically to preserve them.

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
			improve based on emphasis of natural forces and focus on primitive recreation.	
Designated Wild and Scenic Rivers	The two designated wild and scenic rivers on the Tonto National Forest would not change by alternative and would continue to be managed according to Forest Service policy, direction from the Wild and Scenic River Act, the current or revised forest plan, and comprehensive river management plan direction. The outstandingly remarkable values identified in the river segments would be protected through the sources of management direction listed above.	The two designated wild and scenic rivers on the Tonto National Forest would not change by alternative and would continue to be managed according to Forest Service policy, direction from the Wild and Scenic River Act, the current or revised forest plan, and comprehensive river management plan direction. The outstandingly remarkable values identified in the river segments would be protected through the sources of management direction listed above.	The two designated wild and scenic rivers on the Tonto National Forest would not change by alternative and would continue to be managed according to Forest Service policy, direction from the Wild and Scenic River Act, the current or revised forest plan, and comprehensive river management plan direction. The outstandingly remarkable values identified in the river segments would be protected through the sources of management direction listed above. This alternative has the highest potential for condition of wild and scenic characteristics to improve based on emphasis of natural forces and focus on primitive recreation.	The two designated wild and scenic rivers on the Tonto National Forest would not change by alternative and would continue to be managed according to Forest Service policy, direction from the Wild and Scenic River Act, the current or revised forest plan, and comprehensive river management plan direction. The outstandingly remarkable values identified in the river segments would be protected through the sources of management direction listed above.
Eligible Wild and Scenic Rivers	There is no management direction for Eligible wild and scenic rivers in Alternative A. Therefore, Eligible Wild and Scenic Rivers would be managed according to the Forest Service Handbook 1909.12, Chapter 84.3 – Interim Protection Measures for Eligible or Suitable Rivers. This would not have the same level of protection of outstandingly remarkable values as compared to all action	The river characteristics and outstandingly remarkable values would be protected through application of the plan components and interim management guidelines given in the Forest Service Handbook 1909.12_80. Where eligible wild and scenic rivers overlap with recommended wilderness (approx. 540 acres) in this alternative, there would be	The river characteristics and outstandingly remarkable values identified would be protected through application of the plan components and interim management guidelines given in the Forest Service Handbook 1909.12_80. Where eligible wild and scenic rivers overlap with recommended wilderness (approx. 5,120 acres) in this alternative, there would be	The river characteristics and outstandingly remarkable values would be protected through application of the plan components and interim management guidelines given in the Forest Service Handbook 1909.12_80. Condition of outstandingly remarkable values may decline based on emphasis of development and increase in non-conforming uses outside of

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
	alternatives, which could lead to a decline in quality of outstandingly remarkable values.	stricter management direction, which could lead to enhanced protections of the outstandingly remarkable values in these areas (e.g., limited access to wild and scenic river corridors which would lessen human impacts).	stricter management direction, which could lead to enhanced protections of the outstandingly remarkable values in these areas (e.g., limited access to wild and scenic river corridors which would lessen human impacts).	wilderness boundary. This could lead to more access outside of the river corridor and heavier use along the eligible river segments.
Designated and Recommended Research National Areas and Botanical Areas	The three existing research natural areas and two proposed research natural areas in this alternative would be managed appropriate to the rationale for establishment or recommendation and therefore these features identified would be protected. There are no recommended botanical areas in this alternative and so there would be no specific management direction to protect the botanical resources that exist in other alternatives.	The existing 3 research natural areas in this alternative would be managed appropriate to the rationale for establishment or recommendation and therefore these features identified would be protected within this alternative. Plan direction provided for four recommended research natural areas and three recommended Botanical Areas provide additional use restrictions in these areas and therefore resource conditions (e.g., water quality, soil health) may improve.	The existing 3 research natural areas in this alternative would be managed appropriate to the rationale for establishment or recommendation and therefore these features identified would be protected within this alternative. Plan direction provided for four recommended research natural areas and three recommended Botanical Areas may provide additional use restrictions in these areas and resource conditions (e.g., water quality, soil heath) may improve.	The existing 3 research natural areas in this alternative would be managed appropriate to the rationale for establishment or recommendation and therefore these features identified would be protected within this alternative. No recommended research natural areas or Botanical Areas exist in this Alternative so there would be no specific management direction to protect the botanical or natural resources special to these areas that exist in other alternatives.
Inventoried Roadless Areas	Inventoried roadless areas would be managed in accordance with current regulation and policy, which requires the maintenance of roadless qualities.	Inventoried roadless areas would be managed in accordance with current regulation and policy, which requires the maintenance of roadless qualities. Management direction included in the forest plan is applicable to this alternative and allows for the best management and protection of inventoried roadless areas and the associated effects, therefore the revised plan could enhance current roadless character	Inventoried roadless areas would be managed in accordance with current regulation and policy, which requires the maintenance of roadless qualities. Management direction included in the forest plan is applicable to this alternative and allows for the best management and protection of inventoried roadless areas and the associated effects, therefore the revised plan could enhance current roadless character	Inventoried roadless areas would be managed in accordance with current regulation and policy, which requires the maintenance of roadless qualities. Management direction included in the forest plan is applicable to this alternative and allows for the best management and protection of inventoried roadless areas and the associated effects, therefore the revised plan could enhance current roadless character

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
		within inventoried roadless areas. Approximately 6,226 acres of inventoried roadless areas will be managed as recommended wilderness in this alternative, which provides greater protections to the roadless qualities in areas with overlapping management, which could lead to enhanced protection of the roadless qualities in the area.	within inventoried roadless areas. Approximately 113,964 acres of inventoried roadless areas will be managed as recommended wilderness in this alternative, which provides greater protections to the roadless qualities in areas with overlapping management, which could lead to enhanced protection of the roadless qualities in the area.	within inventoried roadless areas.
National Trails	Comprehensive plans and /or establishment reports would be utilized to manage National Trails on the Tonto National Forest, which provides guidance and protection of important features of national trails.	Comprehensive plans and /or establishment reports would be utilized to manage National Trails on the Tonto National Forest, which provides guidance and protection of important features of national trails. Additional forest specific management outlined in the forest plan would improve user experience with less user conflicts; and improve resource conditions with sustainable practices in place.	Comprehensive plans and /or establishment reports would be utilized to manage National Trails on the Tonto National Forest, which provides guidance and protection of important features of national trails. Additional forest specific management outlined in the forest plan would improve user experience with less user conflicts; and improve resource conditions with sustainable practices in place.	Comprehensive plans and /or establishment reports would be utilized to manage National Trails on the Tonto National Forest, which provides guidance and protection of important features of national trails. Additional forest specific management outlined in the forest plan would improve user experience with less user conflicts; and improve resource conditions with sustainable practices in place.
Significant Caves	Under all alternatives caves determined to be significant will be governed under provisions of the Federal Cave Resources Protection Act, which guides the resource protection of our significant caves.	Under all alternatives caves determined to be significant will be governed under provisions of the Federal Cave Resources Protection Act, which guides the resource protection of our significant caves.	Under all alternatives caves determined to be significant will be governed under provisions of the Federal Cave Resources Protection Act, which guides the resource protection of our significant caves.	Under all alternatives caves determined to be significant will be governed under provisions of the Federal Cave Resources Protection Act, which guides the resource protection of our significant caves.
Lakes and Rivers Management Area	The lakes and rivers management area is not present in alternative A.	With the identification of the lakes and rivers management area in this alternative there is additional guidance to sustain	The lakes and rivers management area is not present in alternative C.	With the identification of the lakes and rivers management area in this alternative there is additional guidance to sustain

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
	The land surrounding the lakes and rivers which has been identified as the corridor for the Lakes and Rivers management area will be managed the same as the general forest, therefore effects to these areas from other resources would be consistent with potential forest wide impacts.	and promote the high-use and enhanced recreation these areas provide, which is supported by the visitor impact studies that showed one of the most effective management solutions to address visitor impacts is to limit types of use with higher impacts to specific areas.	The land surrounding the lakes and rivers which has been identified as the corridor for the Lakes and Rivers management area will be managed the same as the general forest, therefore effects to these areas from other resources would be consistent with potential forest wide impacts.	and promote the high-use and enhanced recreation these areas provide, which is supported by the visitor impact studies that showed one of the most effective management solutions to address visitor impacts is to limit types of use with higher impacts to specific areas.
Salt River Horse Management Area	The salt river horse management area is not present in alternative A. It does not provide any plan components or management approaches for the Salt River Horses. Therefore, the Salt River horse herd but would continue to have negative impacts on the natural resources due to the large number of horses in the herd and the competing uses of the land.	Alternatives B has minimal plan components for management within the Salt River Horse Management Area including desired conditions. The desired conditions promote a safe environment for multiple uses of the forest in colocation with the Salt River horses. Until a management plan for the herd is finalized and implemented by Arizona Department of Agriculture, the extent of how this alternative would affect the herd and management of the herd cannot be determined.	Alternatives C has minimal plan components for management within the Salt River Horse Management Area including desired conditions. Alternative C would have similar effects as the other action alternatives, with the main difference being allowable access to manage the herd from an emphasis on primitive recreation. Until a management plan for the herd is finalized and implemented by Arizona Department of Agriculture, the extent of how this alternative would affect the herd and management of the herd cannot be determined.	Alternatives C has minimal plan components for management within the Salt River Horse Management Area including desired conditions. The desired conditions promote a safe environment for multiple uses of the forest in colocation with the Salt River horses. Until a management plan for the herd is finalized and implemented by Arizona Department of Agriculture, the extent of how this alternative would affect the herd and management of the herd cannot be determined.
Saguaro Wild Burro Management Area	The Saguaro Wild Burro management area is present in all alternatives. The area does not have any burros and will be managed as such, therefore effects to this area will be consistent with forest wide impacts.	The Saguaro Wild Burro management area is present in all alternatives. The area does not have any burros and will be managed as such, therefore effects to this area will be consistent with forest wide impacts.	The Saguaro Wild Burro management area is present in all alternatives. The area does not have any burros and will be managed as such, therefore effects to this area will be consistent with forest wide impacts.	The Saguaro Wild Burro management area is present in all alternatives. The area does not have any burros and will be managed as such, therefore effects to this area will be consistent with forest wide impacts.

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
Apache Leap Special Management Area	Apache Leap Special Management Area is included in all alternatives. The area will be managed preserving the area's natural character, allowing traditional uses by Indian Tribes, and protecting and conserving the cultural and archeological resources of the area.	Apache Leap Special Management Area is included in all alternatives. The area will be managed preserving the area's natural character, allowing traditional uses by Indian Tribes, and protecting and conserving the cultural and archeological resources of the area.	Apache Leap Special Management Area is included in all alternatives. The area will be managed preserving the area's natural character, allowing traditional uses by Indian Tribes, and protecting and conserving the cultural and archeological resources of the area.	Apache Leap Special Management Area is included in all alternatives. The area will be managed preserving the area's natural character, allowing traditional uses by Indian Tribes, and protecting and conserving the cultural and archeological resources of the area.

Designated Wilderness

Affected Environment

Wilderness areas are congressionally designated and defined in the Wilderness Act of 1964 as:

> A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain.

In the 1964 law, Congress acknowledged the immediate and lasting benefits of wild places, by passing landmark legislation that permanently protected some of the most natural and undisturbed places in America. The Wilderness Act established the National Wilderness Preservation System "...to secure for the American people of present and future generations the benefits of an enduring resource of wilderness."

The Wilderness Act prohibits permanent roads and the use any form of motorized or mechanized transport within wilderness areas. The Wilderness Act requires management of human-caused impacts and protection of the area's wilderness character to ensure that it is "unimpaired for the future use and enjoyment as wilderness."

The Wilderness Act describes wilderness using the following qualities of "wilderness character":

- untrammeled – free from modern human control or manipulation;
- natural – where the natural condition of the land, its plants, wildlife, water, soil, air and the ecological processes are managed, protected and preserved;
- undeveloped – retaining its primeval character and influence, as is essentially without permanent improvements or human occupation;
- outstanding opportunities for solitude or primitive and unconfined recreation – opportunities for solitude or primitive and unconfined recreational experiences; and
- other features of value, which are ecological, geological or other features of scientific, educational, scenic, or historical value, are truly unique and essential to the character of a particular wilderness, but this may not be applicable to all wilderness areas.

Wilderness areas are meant to be protected, have their wilderness character preserved, and be administered for the use and enjoyment of the American people now and in the future.

The Tonto National Forest manages eight designated wilderness areas: Four Peaks (60,688 acres), Hellsgate (37,427 acres), Mazatzal (247,995 acres), Pine Mountain (11,498), Salome (18,519 acres), Salt River Canyon (32,096 acres), Sierra Ancha (20,237 acres), and the Superstition Wilderness (160,115 acres). The Pine Mountain Wilderness has shared management with the Prescott National Forest.

Designated wilderness areas provide unique opportunities for nonmotorized quiet recreation, solitude and challenge. These areas provide recreation opportunity spectrum settings of primitive and semiprimitive nonmotorized classes. Of the approximately 4.8 million visitors to the Tonto National Forest, over 150,000 enjoy visiting wilderness (USDA Forest Service 2009a). The Wilderness Act prohibits permanent roads and the use of vehicles, and any other forms of motorized equipment and equipment used for mechanical transport. These include the use of motor vehicles, motorboats, motorized equipment, bicycles, hang gliders, wagons, carts, portage wheels, and the landing of aircraft (including helicopters), unless provided for in specific legislation. Emergency use of otherwise prohibited craft, vehicles, and equipment is allowed to protect human health and safety, according to section 4c of the Wilderness Act. There is no law or policy that prohibits motorized use up to the boundary of designated wilderness. Current system roads exist within or adjacent to wilderness boundaries. Many of these existed prior to wilderness designation in 1964 or 1984. The existing roads in wilderness are documented in the enabling legislation or allowed under special use permits for access to private inholdings within the wilderness.

Each of the wilderness areas on the Tonto are described in the specific sections that follow.

Four Peaks Wilderness Area

Four Peaks Wilderness was designated in 1984 and contains 60,688 acres with a major mountain rising up in its center from the desert foothills. The Four Peaks Wilderness is located on the Mesa and Tonto Basin Ranger Districts. The Four Peaks themselves are visible for many miles and are one of the most widely recognized landmarks in central Arizona. The rapid change in elevation produces interesting and unique plant and animal communities. Elevations range from 1,900 feet near Apache Lake to 7,600 feet on Brown's Peak.

Hellsgate Wilderness Area

Hellsgate Wilderness was designated in 1984 and contains 37,427 acres on the Payson and Pleasant Valley Ranger Districts. The Hellsgate Wilderness lies in the central mountain belt of Arizona at the base of the Mogollon Rim. Upper Tonto Creek, a perennial waterway cuts a deep incision through the center of the wilderness, creating topographic relief in the canyon up to 1,000 vertical feet. This creates deep emerald pools sometimes separated by impassable falls. The area also contains Haigler Creek with its impressive rock formations.

Mazatzal Wilderness Area

The Mazatzal Wilderness contains 247,995 acres on both the Tonto and Coconino National Forests. The Tonto National Forest portion of this wilderness area is located in the Cave Creek, Mesa, Payson and Tonto Basin Ranger Districts. The name Mazatzal translates to "land of the deer." On the western side of the Mazatzal Wilderness, below the steep brush covered foothills, the Verde River flows through the Sonoran Desert. Elevations range from 2,060 feet along the Verde River to 7,903 feet on Mazatzal Peak. There is an extensive system of trails: their condition varies from very good to very poor.

Pine Mountain Wilderness Area

The 20,061-acre Pine Mountain Wilderness is managed by the Prescott National Forest. An 11,498-acre portion of the Pine Mountain Wilderness is located in the Cave Creek Ranger District on the northern boundary of the Tonto National Forest, west of the Mazatzal Wilderness area. At 6,814 feet, Pine Mountain is the highest point overlooking the Verde River. On the mountain's southeastern side, the unmistakable steep and rocky Skeleton Ridge falls toward the Verde River, which is designated as a wild and scenic river. On the rim there is an "island" of tall ponderosa pine and Douglas-fir surrounded by desert mountains and hot dry mesas covered in pinion and juniper, cut by rugged canyons. Despite scant water, wildlife abounds here on forested slopes and in the canyons, especially game animals.

Salome Wilderness Area

The Salome Wilderness, designated in 1984, contains 18,519 acres on the Pleasant Valley and Tonto Basin Ranger Districts. The area features a rugged canyon with steep slopes, outcroppings of bedrock, and precipitous bluffs. Elevations range from 2,600 feet at the lower end of Salome Creek to 6,500 feet on Hopkins Mountain. Salome Creek and Workman Creek are small, perennial streams snaking through the bottom of these scenic canyons. Spring and fall are ideal times to visit this area; however, with only four trails covering 18.5 miles, access is limited.

Salt River Canyon Wilderness Area

The Salt River Canyon Wilderness, designated in 1984, contains 32,096 acres on the Globe and Tonto Basin Ranger Districts. This Wilderness contains approximately 32,100 very rugged acres and was established in 1984. The Salt River bisect the wilderness for its entire length. Elevations range from 2,200 feet at the canyon's lower end to 4,200 feet on White Ledge Mountain. This area can be visited practically any time; however, there are no maintained trails within the entire wilderness. Travel is basically done by raft or kayak during the short and dangerous river-running season.

Sierra Ancha Wilderness Area

First established in 1933 as a "Primitive Area," this 20,237-acre wilderness is full of surprises. While not large in acres, this wilderness area includes precipitous box canyons, high cliffs, and pine-covered mountains. The extremely rough topography limits (and often prohibits) cross-country travel; however, there is an extensive system of trails (trail condition varies from good to poor). A wide variety of plant and animal species are found here. Species range from those found in the desert to those found at 8,000 feet.

Superstition Wilderness Area

The Superstition Wilderness was established as the Superstition Primitive Area by the Chief of the Forest Service in February 1939. It was then updated to a wilderness classification in 1940 and became a part of the wilderness preservation system with the passage of the Wilderness Act in 1964. The Arizona Wilderness Act of 1984 added 35,000 acres expanding the wilderness area to its present size and shape. The area contains 160,115 acres on the Globe, Mesa, and Tonto Basin Ranger Districts. One nationally known topographic feature within this wilderness is “Weavers Needle” a weathered volcanic plug that rises to a height of 4,553 feet. The Superstition Mountains themselves are a well-known feature that is clearly visible from the Town of Apache Junction and other areas of the East Valley.

Environmental Effects

Effects Common to All Alternatives

Across all alternatives there is 588,575 acres managed as designated wilderness, which accounts for just over a fifth of the forest (20.3 percent). Designated wilderness would continue to be managed using the applicable law, regulation and policy to preserve wilderness character. The wilderness character for which it has been designated will be maintained for all wilderness areas on the Tonto National Forest. Wilderness implementation plans will be utilized for the management of these areas. There are no changes in acres of designated wilderness areas. Regulations for group size is the same across all alternatives.

Desired conditions, standards, and guidelines in all alternative cover concepts to improve or maintain wilderness character including apparent naturalness (using natural materials for facilities and signs, managing for native plant and animal species, management of improvements), untrammeled character (use of fire in its natural ecological role), undeveloped (removal of nonconforming facilities, prohibition of motorized and mechanical conveyances), outstanding opportunities for primitive and unconfined recreation (limitations on outfitter and guide services, maximum group size). Collectively, plan guidance along with the developed implementation plans would help maintain or enhance wilderness characteristics across all alternatives.

Effects of Alternative A

Under alternative A, management direction in the current forest plan for designated wilderness is included in management areas: 1B, 1C, 2A, 2B, 3A, 3B, 3C, 3D, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 6G, 6H, 6I. The standards and guidelines within this alternative cover concepts to improve or maintain wilderness character, including using natural materials for facilities and signs, management of livestock improvements, use of fire in its natural ecological role, maximum group size limits, prohibited organized recreation events, trail construction consistent with a primitive recreation opportunity spectrum setting, maximum group size. Collectively, this plan guidance would help maintain wilderness character across the forest but would not lead to an enhancement of this same character.

That said, management of designated wilderness areas is not consistent across wilderness areas under this alternative, which has the potential to result in unpredictable management of this resource. Inconsistent management of wilderness resources could lead to a greater impact on the wilderness character within each of the areas, including loss of solitude in areas where there are high recreation impacts, degradation of natural resource within the areas from high use, and a decreased value of the wildness of the land to recreationalists.[27]

The 1985 plan contains no direction with regard to the management of Tonto's resources in response to climate change. Plants and animals would be extremely vulnerable to the consequences of atypical temperatures and rainfall patterns, which include drought; increased number and severity of wildfires; increased stress on vegetation, including insect and disease outbreaks; and decreased water yield and availability. Each of these consequences may affect one or more resources within designated wilderness, some more than others, depending on location and uses. As an example, in the absence of appropriate management, drought may stress native vegetation to such an extent that invasive nonnative species outcompete it for nutrients and water in a wilderness, potentially changing habitat and displacing species to other non-wilderness locations. This, in turn, may diminish the visitor experience in the wilderness.

Effects Common to All Action Alternatives

In alternatives B, C, and D, plan components for designated wilderness are consistent across the forest with the overall intent of clarifying management actions allowable in these areas. A primitive experience would be maintained for all wilderness areas. Natural ecological processes and disturbance would be the primary forces affecting the composition, structure, and patterns of vegetation. Wilderness areas would continue to be managed to protect and maintain their wilderness characteristics. Regulations for group size are the same across all alternatives (maximum group size for camping/hiking/riding at 15 people and a maximum number of pack and saddle stock allowed in a group is 15 head) in order to preserve opportunities for solitude.

This direction would better ensure meeting local wilderness stewardship priorities and collaboration between resource areas required to manage wilderness resources. Ultimately, this direction would lead to greater protection and enhancement of wilderness character, than alternative A.

Effects of Alternative B

There are no additional effects specific to alternative B.

Effects of Alternative C

Alternative C has objectives for the most prescribed fire and naturally ignited wildfires as a means to accomplish vegetation restoration. Although these actions could only occur in wilderness if they improved

[27] For specific effects of high use recreation, see the recreation section of this document.

wilderness character, the magnitude of fires could affect air quality and visual conditions due to the amount of smoke they would produce. Additionally, there could have negative effects on wilderness character, including the degradation of scenic values from the area, dependent on proximity of fires to designated wilderness areas[28].

In this alternative all vacant allotments will be closed if they are currently vacant. The closure of vacant allotments on the forest would increase the apparent naturalness of designated wilderness areas, due to the reduction of impacts from cattle (e.g., overgrazing), the removal of nonconforming improvements, and the decrease of encounters with cattle which in turn increases the level of solitude in the area.

Alternative C favors nonmotorized and primitive recreation opportunities across the forest. In this alternative there is a greater emphasis on the recreation types that are valued within designated wilderness areas, which could result in a prioritization of maintaining and enhancing the unconfined recreation values of designated wilderness on the forest. This would result in the enhancement of the wilderness character designated wilderness areas across the forest. In turn, the increased value of these recreation types could reduce the solitude within designated wilderness areas because there is a potential increase in the visitors to designated wilderness on the forest. By increasing visitation in an area, there could be increased resource damage (e.g., trampled vegetation, user created trails)[29] which would take away from the wilderness character of an area.

Effects of Alternative D

Alternative D has the least amount of user restrictions with an emphasis on motorized and accessible recreation. The focus of this alternative in providing for, and anticipating, an increased level of visitation to the forest for developed recreational opportunities, there may be a greater effect to the character of designated wilderness areas, primarily along the boundaries. The more acres allocated to more development-oriented management area designation, the higher likelihood of negative effects (e.g., loss of solitude, habitat degradation, and increase in presence of invasive species) to existing wilderness.

Non-wilderness uses adjacent to wilderness may have a negative effect on the quality of wilderness recreation experiences. For example, where roads and motorized activities occur along the wilderness boundary, the incidence of illegal use of motorized and mechanized vehicles in the wilderness may increase. High use roads close to the boundary provide easy recreation access to wilderness and tend to increase use[30]. The increased use of off-highway vehicles may result in increased unauthorized use in wilderness and damage wilderness character. As use increases, compliance with regulations could become a greater challenge as recreational participants increase and often compete for limited or popular space and resources. Many designated areas emphasize solitude, challenge, unmodified natural environments, and minimal encounters, signs of other users, or both can be more vulnerable to increased visitation and use conflicts.

Alternative D emphasizes mechanical means of vegetation managements. Timber harvest activity in areas adjacent to wilderness may affect qualities of wilderness character, specifically opportunities for solitude or primitive and unconfined recreation. Vegetation management actions outside of wilderness may affect the remoteness from occupied and modified areas from within the wilderness. Additionally, the natural quality of wilderness character may be impaired through altering plant and animal species and

[28] For the specific effects of fire on scenic resources, see the Scenery section of this document.
[29] For the specific effect of increased recreational use on natural resources, see the Recreation section of this document.
[30] For the specific effect of increased recreational use on natural resources, see the Recreation section of this document.

communities in areas adjacent to wilderness, and through an increased potential for the introduction of nonnative species though ground-disturbing activities.

Recommended Wilderness

Affected Environment

When revising the forest plan, the Tonto National Forest is required to identify and evaluate lands that may or may not be suitable for inclusion in the National Wilderness Preservation System and determine whether to recommend to Congress any such lands for wilderness. A description of this process can be found in Chapter 70 of the Forest Service Land Management Planning Handbook 1909.12. This process includes the following four steps:

> Inventory: Identify and create an inventory of all lands that may or may not be suitable for inclusion in the National Wilderness Preservation System using a given set of criteria.
>
> Evaluation: Evaluate the wilderness characteristics of all lands included in the inventory that may be suitable for inclusion in the National Wilderness Preservation System using a given set of criteria and assign a ranking of high, moderate, low, or no for their wilderness character.
>
> Analysis: Based on the above rankings, the forest supervisor will determine which areas to further analyze through the National Environmental Policy Act process.
>
> Recommendation: Based on the above analysis the forest supervisor will decide which areas, if any, to recommend to Congress for inclusion in the National Wilderness Preservation System.

Lands evaluated and analyzed through this process and the resulting National Environmental Policy Act analysis are only preliminary administrative recommendations. Recommended wilderness is distinct from designated wilderness and is managed in accordance with forest plan direction as opposed to the Wilderness Act. Congress has reserved the authority to make final decisions on wilderness designation.

Table 203 outlines the recommended areas identified through the Wilderness Recommendation Process[31] for each alternative. Several factors were considered in determining the recommended wilderness areas in each alternative. The areas were selected based upon consideration of the information within the wilderness evaluation[32]. The evaluation indicated which areas had wilderness characteristics such as naturalness, outstanding opportunities for solitude or primitive and unconfined recreation, and other special features of ecological, geological, or scientific, educational, scenic, or historical value. Based on the level of wilderness characteristics, no areas which received a “low” or “no” overall wilderness characteristic ranking are analyzed in the environmental impact statement.

Table 203. Areas managed as recommended wilderness in one or more alternatives

Recommended Wilderness Area (Polygon number – Name)	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)	Alternative D (acres)
Polygon 1 – Wood Canyon	0	0	10,557	0
Polygon 10 – Superstition Wilderness Contiguous C	0	0	36	0

[31] Detailed information about the Wilderness Recommendation Process and all areas considered can be found in Volume 4 of this final EIS.
[32] More information can be found on our website at https://www.fs.usda.gov/detailfull/tonto/landmanagement/planning/?cid=fseprd594560&width=full.

Recommended Wilderness Area (Polygon number – Name)	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)	Alternative D (acres)
Polygon 12 – Superstition Wilderness Contiguous A	0	13	13	0
Polygon 15 – Haunted Canyon	0	0	11,059	0
Polygon 16 – JK Mountain	0	0	5,267	0
Polygon 18 – Superstition Wilderness Contiguous B	0	28	28	0
Polygon 22 – Superstition Wilderness Contiguous D	0	0	683	0
Polygon 24 – Superstition Wilderness Contiguous E	0	0	827	0
Polygon 28 – Salt River Canyon Wilderness Contiguous C	0	0	13	0
Polygon 32 – Coronado Mesa	0	6,515	6,515	0
Polygon 36a – Mesquite Flat	0	0	2,560	0
Polygon 38 – Four Peaks Wilderness Contiguous B	0	0	8	0
Polygon 40 – Four Peaks Wilderness Contiguous A	0	9	9	0
Polygon 43 – Rockinstraw	0	0	6,312	0
Polygon 46 – Salt River Canyon Wilderness Contiguous A	0	614	614	0
Polygon 52 – Salt River Canyon Wilderness Contiguous B	0	94	94	0
Polygon 57 – Dutchwoman	0	0	3,806	0
Polygon 60a - Bumblebee	0	0	30,512	0
Polygon 65a – Grantham Peak	0	0	590	0
Polygon 65b – Zimmerman	0	0	16,217	0
Polygon 66 – Bull Canyon	0	0	7,712	0
Polygon 67 – Sierra Ancha Wilderness Contiguous A	0	50	50	0
Polygon 69 – Sierra Ancha Wilderness Contiguous B	0	67	67	0
Polygon 70a – Picacho	0	0	15,899	0
Polygon 71 – Sierra Ancha Wilderness Contiguous C	0	20	20	0
Polygon 72 – Sierra Ancha Wilderness Contiguous D	0	0	10	0
Polygon 73 – Sierra Ancha Wilderness Contiguous E	0	0	18	0
Polygon 74 – Sierra Ancha Wilderness Contiguous F	0	0	24	0
Polygon 76 – Boulder	0	0	72,508	0
Polygon 77 – Sierra Ancha Wilderness Contiguous G	0	0	20	0
Polygon 78 – Sierra Ancha Wilderness Contiguous H	0	0	8	0
Polygon 79 – Blue Peak	0	0	23,283	0

Recommended Wilderness Area (Polygon number – Name)	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)	Alternative D (acres)
Polygon 83 – Sierra Ancha Wilderness Contiguous I	0	0	6	0
Polygon 84 – Indian Butte	0	6,140	6,140	0
Polygon 85 – Sierra Ancha Wilderness Contiguous J	0	0	7	0
Polygon 87 – Rock House	0	0	5,214	0
Polygon 91 – Baker Mountain	0	0	10,565	0
Polygon 93d – Tanner Peak	0	0	21,842	0
Polygon 96c – Alder Point	0	0	14,844	0
Polygon 101a – Gun Creek	0	29,657	29,657	0
Polygon 107 – Diamond Butte	0	0	15,330	0
Polygon 108 – Smokey Hollow	0	0	1,634	0
Polygon 119a – Lime Creek	0	0	57,771	0
Polygon 119b – Mullen Mesa	0	0	3,661	0
Polygon 119e – Dugan	0	0	1,805	0
Polygon 119f – Rugged Mesa	0	0	11,292	0
Polygon 123a – Tumbleweed	0	0	4,722	0
Polygon 123b – Pigeon Creek	0	0	5,828	0
Polygon 126 – Childs	0	0	402	0
Polygon 131 – Fossil Springs	0	0	30	0
Total Acres Recommended Wilderness in Alternative	0 acres	43,204 acres	399,029 acres	0 acres

Descriptions of these areas, along with a complete outline of the wilderness recommendation process, can be found in volume 4 of the final environmental impact statement Appendix D: Wilderness Recommendation Process.

Environmental Effects

Effects Common to Alternative A and D

Alternatives A and D do not have any recommended wilderness areas. Under these alternatives there is a potential increase in development or motorized and mechanized uses permitted in more areas of the Forest, which could degrade areas that currently possess wilderness characteristics on the Forest. These impacts include the potential for a decrease in opportunities for solitude, which limits visitor’s ability to feel alone across the forest, and a maintenance of or reduction of primitive recreation types. In areas where there are primitive recreation opportunities, recreational pressure and crowding would be rare, but slightly more likely compared to other alternatives since fewer wilderness opportunities would be available across the forest[33].

Alternatives A and D would provide more opportunities for recreation development across the forest, including an increase in rustic or rudimentary facilities that are typically prohibited in recommended wilderness. Those desiring semiprimitive type recreation, access to rustic facilities, or the ability to hold

[33] For the specific effect of increased recreational use on natural resources, see the recreation section of this document.

competitive events would have more options for areas to recreate, and crowding in semiprimitive, nonmotorized areas would be slightly reduced.

Areas that had been identified as potential recommended wilderness areas could become more developed, with potential impacts to soils (e.g., compaction), watershed condition (e.g., water quality), or wildlife habitat (e.g., loss of connectivity). However, any impacts would be mitigated according to the plan components for those specific resources and would be minimal[34]. Opportunities for restoration would be greatest since no additional limitations would be imposed on the methods or tools that could be used within those areas. This allows for the forest to be flexible in the approaches taken for managing vegetation across the forest, rather than limiting types of activities and increasing the possibility for restoration to be less efficient.

Effects Common to Alternative B and C

Alternatives B and C recommend different recommended wilderness areas, but the management of the areas is the same. Recommended wilderness areas include plan components that would maintain the wilderness characteristics until the area is designated as wilderness by Congress. This would ensure that the social and ecological characteristics for which an area is recommended persists, which could result in enhanced wildlife connectivity, provide ecosystem benefits to local communities, and protection of cultural and historic resources.

These alternatives include standards that specify no new roads, energy developments, or sale of common variety minerals are to be allowed (RWMA-S-01, RWMA-S-03, RWMA-S-04). By limiting these activities, the naturalness of the area would be maintained, which allows visitors the opportunity to be surrounded by only natural elements while in these areas. Activities associated with valid existing rights, mainly existing mining leases, would continue in recommended wilderness.

Plan direction indicates that the areas are managed for the highest scenic quality as well as primitive recreation (RWMA-G-09, RWMA-G-10). This plan direction would help to maintain the apparent naturalness of the area, especially by limiting the addition of any further improvements as defined in the wilderness evaluation (e.g., roads, trails, and facilities). Primitive recreation opportunities and solitude will also be maintained or enhanced by the limitation on development, especially roads, and limitation on motorized and mechanized uses. Since no limitations exist on dispersed recreation that includes nonmotorized and non-mechanized activities (e.g., hiking, backpacking, fishing, hunting, horseback riding), primitive recreation opportunities would be maintained or expanded. In addition, the quality of this sort of primitive recreation as well as opportunities for solitude would increase as there would be less exposure to and conflict with motorized and mechanized users. This would allow for high quality primitive and unconfined recreation opportunities which have challenge and risk associated with them.

The presence of recommended wilderness can affect existing wilderness. Designation of new wilderness may change patterns of recreation use, create larger contiguous areas, and reduce pressure within existing wilderness areas. Opportunities for wilderness-dependent recreation may increase. Motorized use would be prohibited in areas recommended for wilderness designation. Motorized use (e.g., motorcycle, all-terrain vehicle, utility vehicle, and full-size vehicle use) would be displaced from recommended wilderness areas and could concentrate into other areas on the forest. Similarly, bicycles (a form of mechanical transport) would be restricted to existing system roads and trails until Congressional

[34] Effects of increased development and use on natural resources, and effects of mitigations in place, can be found in the appropriate section for each resource area.

designation, and then bicycles, along with other forms of mechanical transport, would be prohibited, which could move and concentrate mountain biking to other areas of the forest.

Recommended wilderness designations have the potential to change the recreation setting of areas surrounding the Arizona National Scenic Trail. Outside of designated wilderness areas the trail is currently open to mountain bike use and many people mountain bike the entire Arizona Trail using roads or other trails to avoid wilderness. Though mountain biking would be an allowed used in recommended wilderness, the potential for additional wilderness designations, such as the Boulder Recommended Wilderness, would enhance the wilderness experience for hikers or equestrians using the trail and it may better protect significant scenic, historic and natural resources in the trail setting. Recommended wilderness could have a potentially negative affect on the recreation experience of mountain bikers if it causes longer detours on roads or through less scenic areas.

Recommended wilderness areas would continue to provide uses that are beneficial for maintaining traditional and cultural uses, providing economic opportunities, and providing ecosystem services benefits to local communities. From a forest-level perspective, the recreational users express social values for wilderness areas in numerous ways: solitude for psychological health; continuous forested lands for habitat and intact landscapes; spiritual uses for solace of open, quiet, beautiful places; for wildlife and pristine settings; and economic opportunities for tourism, hunting, and fishing (Schuster et. Al, 2004). With recommended wilderness, these values expressed would be more abundant across the forest. Additionally, the presence of recommended wilderness would allow visitors the opportunity to experience natural ecological processes and disturbances with a limited amount of human influence.

Social values for non-wilderness areas are expressed by recreational users for a variety of reasons: providing a balance of nonmotorized and motorized uses; allowing multiple uses including hunting, fishing, recreation, tourism; and timber harvesting to manage for forest health and to support community economics. Recreational users often express competing or conflicting social values for wilderness and non-wilderness uses for the same places (such as motorized and nonmotorized access; unmanaged and managed landscapes; expansion of recreation trails and limitations on uses). Within the Tonto National Forest, there remains a wide variety of opportunities for unconfined outdoor recreation experiences within both wilderness type and non-wilderness National Forest System lands in both of these alternatives. Overall, although a few uses would be incompatible with recommended wilderness designation, most current uses of these areas are compatible with wilderness character and would be able to continue.

Through the identified management of recommended wilderness areas, the characteristics of areas allocated to recommended wilderness would be protected and enhanced. The degree to which the areas are natural or appear to be natural would be increased through conserving plant and animal species and communities, physical resources, and biophysical processes. The degree to which the area appears to be free from disturbance would be enhanced by reducing actions that manipulate the biophysical environment, and undeveloped quality would improve through reducing structures, installations and developments not related to recreation. Opportunities for solitude or primitive and unconfined recreation would be improved by retaining remoteness and by excluding facilities that decrease self-reliance. Additional qualities, including ecological, geological, or other features of scientific, educational, scenic, or historical value, would be conserved. Enhancing these qualities would have a beneficial effect on wilderness characteristics and values.

Alternative A Effects

Because it lacks climate change direction, the 1985 plan would have the same effects on vegetation, water, air quality, and wildlife resources in recommended wilderness as those described for designated wilderness.

Alternative B Effects

Alternative B adds about 43,204 acres of recommended wilderness, split into 11 management areas. This represents managing 1.46 percent of the Tonto National Forest as recommended wilderness. More information including the names, locations, and characteristics of the recommended wilderness areas in this alternative can be found in appendix D[35].

Most recommended areas in this alternative would assist in wilderness management where they are adjacent to existing designated wilderness but follows more prominent topographic features than the current boundary or fill in holes within the designated wilderness. As described above, the addition of recommended wilderness along designated wilderness may change patterns of recreation use, create larger contiguous areas, and reduce pressure within existing wilderness areas from outside motorized use.

The roads surrounding the Indian Butte Recommended Wilderness Area are part of a proposed off-highway vehicle recreation area. Non-wilderness uses adjacent to recommended wilderness may have a negative effect on the quality of wilderness recreation experiences. Where roads and motorized activities occur along the boundary, the incidence of prohibited use of motorized and mechanized vehicles into the wilderness may increase, which could cause degradation of the apparent naturalness of the area through soil compaction, trampling of plants, and unauthorized routes intruding into the area. High standard roads close to the boundary provide easy recreation access and tend to increase use. As use numbers increase, particularly day use, concentrated use affects physical, biological, and social conditions in the recommended wilderness area.[36]

Alternative C Effects

Alternative C adds about 399,029 acres of recommended wilderness, split into 50 management areas. This represents managing 13.45 percent of the Tonto National Forest as recommended wilderness. More information including the names, locations, and characteristics of the recommended wilderness areas in this alternative can be found in appendix D.

The level of protection of wilderness characters across the forest is greatest in alternative C due to the high number of acres managed as recommended wilderness areas. This alternative greatly increases the number of areas without motorized disturbance, which would provide greater protection for the apparent naturalness of areas across the forest. This alternative would also provide the most opportunities for high quality primitive and unconfined recreation opportunities which have challenge and risk associated with them.

In this alternative the plan would include a plan component which states that all vacant allotments will be closed if they are currently vacant. The closure of vacant allotments on the forest would increase the apparent naturalness of recommended wilderness areas, due to the reduction of impacts from cattle (e.g., cow manure, overgrazing), the removal of nonconforming improvements (e.g., improvements made from non-natural materials), and the decrease of encounters with cattle which in turn increases the level of

[35] Effects of the presence of recommended wilderness on other resources is in each specific resource section of this report.
[36] For the specific effect of increased recreational use on physical, biological, and social conditions, see the Recreation section of this document.

perceived naturalness of the area as well as can positively impact the level of solitude in the area, allowing people to feel alone in nature.

Designated Wild and Scenic Rivers

Affected Environment

The National Wild and Scenic Rivers System was created by Congress in 1968[37] to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. There are three classifications of wild and scenic rivers: “wild,” “scenic,” and “recreational.” For a river to be eligible for wild and scenic river designation, it must be free flowing and, with its adjacent land area, must possess one or more outstandingly remarkable values. Outstandingly remarkable values are specific to each river segment and may include scenic, recreation, fish, historic, and cultural values (USDA Forest Service 2014b). Wild and scenic rivers contribute to both ecological and social sustainability by preserving the outstandingly remarkable values into the future. As part of the National Wild and Scenic Rivers System, these areas may contribute to the economic sustainability of the surrounding communities by drawing visitors who are interested in visiting areas with wild and scenic rivers, and also through the potential for access to funding from individuals and groups that have an interest in preserving wild and scenic river resources.

The forest has two designated wild and scenic rivers; Fossil Creek 16.8 miles (9.3 miles are designated as wild; 7.5 miles are designated as recreational), and Verde River 40.5 miles (22.2 miles designated as Wild, 18.3 miles designated as scenic). Wild and scenic rivers are meant to preserve outstanding free-flowing rivers to be protected for the benefit and enjoyment of present and future generations. Wild and scenic rivers are congressionally designated.

Fossil Creek

The Fossil Creek Wild and Scenic River is located 100 miles northeast of Phoenix. Fossil Creek was designated by Congress in 2009 and includes 9.3 miles as wild and 7.5 miles as recreational segments. Fossil Creek is located on both the Tonto and Coconino National Forests. The Coconino National Forest has taken the lead for management of the river corridor for both national forests. This includes the management of National Forest System Road 708 from the town of Strawberry that provides access to Fossil Creek. A letter dated December 4, 2012, from the Tonto forest supervisor to the Coconino forest supervisor delegates management responsibility of the Fossil Creek area (except for range management and administration) to the Coconino National Forest (Bosworth 2012).

The comprehensive river management plan for the Fossil Creek Wild and Scenic River was finalized by the Coconino National Forest in December 2020 and describes the outstandingly remarkable values in further detail for the entire river segment. The comprehensive river management plan also provides a foundation for river management guidance and direction by establishing Forest Service policies to protect and improve the Fossil Creek Wild and Scenic River for future generations. The plan will describe management direction, address site-specific issues, and identify actions to help care for the river corridor.

Verde River

The Verde Wild and Scenic River Area on the Tonto National Forest is approximately 5,692 acres in size located along the western edge of the Mazatzal Wilderness, approximately 20 miles northeast of Cave Creek, Arizona. The scenic river segment is 50 percent located within the Coconino National Forest, 28 percent located within the Prescott National Forest and 12 percent located on the Tonto National Forest.

[37] Public Law 90-542; 16 U.S.C. 1271 et seq.

The scenic classification is a total of 18.3 miles. The wild segment is predominantly located on the Tonto National Forest (93 percent) and 7 percent located on the Coconino National Forest. The wild river area on the Tonto National Forest is within the Mazatzal wilderness and was established as a result of the Arizona Wilderness Act of 1984 that designated this segment of the Verde River as Arizona's first wild and scenic river under the Wild and Scenic Rivers Act.

The Act requires that this segment be administered in such a manner as to protect and enhance its designated outstandingly remarkable scenic, fish and wildlife, and historical and cultural values, while protecting the river's free flowing character and water quality. The comprehensive river management plan for the Verde Wild and Scenic River (USDA Forest Service 2004) describes the outstandingly remarkable values in further detail for the entire wild and scenic river segment. The Prescott National Forest is the lead national forest for management of the Verde Wild and Scenic River Corridor

Environmental Effects

Effects Common to All Alternatives

The two designated wild and scenic rivers on the Tonto National Forest would not change by alternative and would continue to be managed according to Forest Service policy, direction from the Wild and Scenic River Act, the current or revised forest plan, and comprehensive river management plan direction. Comprehensive river management plans provide management of designated wild, scenic, and recreational rivers that comply with direction provided in the forest plan, which provide the protections necessary to maintain or enhance the outstandingly remarkable values present.

- The free-flowing condition, classification, and outstandingly remarkable values for wild and scenic river corridors shall be maintained when implementing projects (DWSRMA-S-01).

The comprehensive river management plan and any future versions of it must be incorporated by reference and would become part of the forest plan; although, best available science can be used in lieu of the comprehensive river management plan if the plan is out of date with science. Application of management direction would constrain the management of other resources within the river corridor, thereby minimizing the negative effects of management activities on the outstandingly remarkable values, which may include reduced scenic value, degraded water quality, interference with water flow, reduction in recreation opportunities, or threats to cultural and historic values.

All alternatives would include desired conditions that preserve or enhance the outstandingly remarkable values, free-flowing condition, and classification of designated wild and scenic rivers (DWSRMA-DC-01). Maintaining the conditions that characterize wild and scenic rivers upholds the standards set forth in the National Wild and Scenic Rivers System Act and benefits present and future generations through the enjoyment of these areas. Moreover, managing these areas to maintain their free-flowing nature and outstandingly remarkable values would help to protect water quality, scenic integrity, areas of cultural or historic significance, and improve riparian habitats, aquatic species health and diversity, especially within the areas designated as wild or scenic.

As populations increase and more people visit the wild and scenic rivers on the Tonto National Forest, the value of managing these areas in their relatively natural condition would increase user satisfaction and contribute to the increased wellbeing of visitors from spending time in these special areas. An increase in visitation to wild and scenic river areas would generate increased economic revenue within the surrounding communities through the sale of food, lodging, bait and tackle, guide services, or other river-based revenue sources. That said, increased visitation to wild and scenic river areas could have some detrimental ecological impacts, such as ground disturbance, increased trash or discarded items, nonnative species introductions or spread, reduced fish populations (through increased fishing pressure), or aquatic habitat degradation. These negative effects should be minimal if managed according to Forest Service policy, direction from the Wild and Scenic River Act, the current or revised forest plan, and comprehensive river management plan direction.

Within the river corridors of designated wild and scenic rivers there is higher protection for: safeguarding clean water; preventing activities that would significantly harm the river's character and benefits; prohibiting new dams or damaging water projects; and protecting land along the river with a quarter-mile protective buffer along the wild and scenic river flowing through publicly owned lands (Hewes and Pitts 2017). The comprehensive river management plans, which include input from local landowners and other stakeholders ensures a shared vision on how to preserve the special character of the river. The designation itself could reduce the impacts of floods; preserve some important ecosystems; enable native plants and animals to thrive; preserve the cultures of communities who once lived by the river; provide exceptional recreation and wildlife viewing; and improve understanding of the evolution of the planet by preserving special rock and geologic formations. Furthermore, they may preserve the quality of life of adjacent landowners, protect and/or increase private property value, and boost local economy by generating income through the growth of recreation and tourism activities.

Eligible Wild and Scenic Rivers

Affected Environment

The National Wild and Scenic Rivers System was created by Congress in 1968 to preserve rivers that contain outstanding natural, cultural, and recreational values in a free-flowing system, and are for the enjoyment of present and future generations.

Over the past thirty years several wild and scenic rivers eligibility studies were conducted on rivers and river segments on the Tonto National Forest. Those studies include the 1984 Arizona Wilderness Act, a Resource Information Report for Potential Wild, Scenic, Recreational River Designations, National Forests of Arizona (USDA Forest Service 1993), and the Fossil Creek Resource Assessment (USDA Forest Service 2017). As a result of this earlier work the Tonto National Forest identified 26 river segments as potentially eligible for wild and scenic rivers designation. Determinations were made using the process outlined in the Wild and Scenic Rivers Act of 1968. That said, when beginning the wild and scenic river eligibility process as part of plan revision[38], the interdisciplinary team reviewed the earlier work from the 1993 effort and determined that an additional, more comprehensive study was required to fulfill the mandates set forth in the 2012 Planning Rule. In the 1993 study not all named streams were evaluated, and a region of comparison was not used to evaluate each segment. Therefore, the potentially eligible segments from the 1993 study were evaluated along with all other named streams during this process.

As part of the Tonto National Forest plan revision process, under the direction of the 2012 Planning Rule (36 CFR Part 219), a new wild and scenic rivers eligibility study was conducted for the Tonto National Forest planning area. For a river to be eligible for the wild and scenic rivers designation, it must be free flowing, and possess one or more outstandingly remarkable values. Outstanding remarkable values include scenery, recreation, fish, historic and cultural, geography, and other values. Further information on the process of selecting national wild and scenic rivers can be found in Chapter 80 of the Land Management Handbook.

[38] For more information about this eligibility study and a list of all segments considered see https://www.fs.usda.gov/detailfull/tonto/landmanagement/planning/?cid=fseprd594556&width=full.

All rivers in the Tonto National Forest were evaluated to determine their eligibility for inclusion in the National Wild and Scenic Rivers System. This evaluation resulted in 19 possible river segments with outstandingly remarkable values on the Forest, totaling 188 miles (table 204). Each river is assigned a classification of wild, scenic, or recreational, based on the free-flowing condition and development level in and around the river at the time it is deemed eligible. There are approximately 66 miles classified as wild, 83 miles classified as scenic, and 40 miles classified as recreational.

Table 204. Eligible wild and scenic rivers, including classifications and outstandingly remarkable values

Stream Name	Ranger District	Segment Length	Classification	Outstandingly Remarkable Values
Arnett Creek / Telegraph Canyon	Globe	3.5 miles	Recreational	Scenery, Ecological
Canyon Creek	Pleasant Valley	7.2 miles	Recreational	Wildlife
Christopher Creek	Payson	2.3 miles	Recreational	Recreation
Cold Spring Canyon	Pleasant Valley	1.7 miles	Wild	Natural
Devil's Chasm	Pleasant Valley	2.5 miles	Wild	Historic
East Verde River	Payson	32.7 miles	Scenic, Recreational	Scenery
Fish Creek	Mesa	5.7 miles	Wild, Scenic	Natural
Greenback Creek	Pleasant Valley, Tonto Basin	5.1 miles	Scenic	Historic
Ledni Líí Creek	Cave Creek	5.2 miles	Scenic	Historic
Lower Tonto Creek	Tonto Basin	3.2 miles	Scenic	Recreation
Pine Creek	Payson	2 miles	Recreational	Geologic
Pueblo Canyon	Pleasant Valley	1.7 miles	Wild	Scenery, Historic
Reno Creek	Tonto Basin	3.6 miles	Scenic	Historic
Salome Creek	Pleasant Valley, Tonto Basin	8.5 miles	Wild	Recreation, Scenery
Tangle Creek	Cave Creek	9.5 miles	Scenic, Recreational	Natural, Scenery
Upper Salt River	Tonto Basin, Globe	59.4 miles	Wild, Scenic	Geologic, Recreation, Historic, Scenery
Upper Tonto Creek	Payson	21.7 miles	Scenic	Recreation, Scenery, Wildlife, Historic
Verde River	Cave Creek	10 miles	Wild, Scenic	Fisheries, Wildlife, Recreation, Historic
Workman Creek	Pleasant Valley	2.3 miles	Recreational	Natural, Scenery

The Forest is required to manage agency-identified eligible wild and scenic river segments to retain their eligibility status until a suitability determination has been made whether or not to recommend them for inclusion in the National Wild and Scenic Rivers System. The Tonto National Forest may authorize projects and activities in eligible rivers or the surrounding river corridor[39] so long as they preserve the free-flowing[40] condition of the river, protect the outstandingly remarkable values that provide the basis of the river's eligibility for inclusion in the system, and do not affect the classification of the river segment. In some cases, free-flow may be positively affected when instream structures promote more natural levels of river processes (e.g., bank erosion, channel shifting, groundwater infiltration, floodplain development) and bed load or debris movement. In the case a project may negatively impact the free-flow characteristics, a suitability study must analyze the effects of designation to other resource values, identify issues, and explore alternatives for protecting river values.

Environmental Effects

Effects Common to All Alternatives

The number and miles of eligible rivers defined in the revised plan do not vary by alternative. In all alternatives the identified eligible wild and scenic rivers and their corridors (one-quarter mile on either side of the river) would be managed in accordance with Forest Service Handbook 1909.12, Chapter 82.5. The presence of an eligible river constrains the type and manner activities that may be conducted within the river corridor. Three constraints would apply to activities proposed under any alternative in all eligible river corridors: (1) the protection of the free-flowing river character; (2) the protection of the identified outstandingly remarkable values; and (3) the maintenance of the preliminary river classification (wild, scenic, or recreational) unless a completed suitability study recommends a less restrictive classification.

Application of the management guidelines found in the Forest Service Handbook (FSH 1909.12_80) would also constrain the management of other resources within the river corridor, thereby minimizing the potential negative effects of management activities on the outstandingly remarkable values, which may include reduced scenic value, degraded water quality, interference with water flow, reduction in recreation opportunities, or threats to cultural and historic values. Management constraints defined in the Forest Service Handbook are specific to water resources projects, hydroelectric power, minerals, transportation system, utility proposals, recreation development, motorized travel, wildlife and fish projects, vegetation management, and domestic livestock grazing[41].

Management direction dictates that activities in eligible wild and scenic river corridors shall comply with interim protective measures outlined in Forest Service Handbook 1909.12, 84.3 (EWSRMA-S-02). This direction places the most restrictions on wild river corridors and the least restrictions on recreational river corridors. For example, the cutting of trees is not allowed in wild river corridors unless it is necessary for human safety or to protect a cultural value at risk but is acceptable within recreational areas to meet resource objectives. Additionally, fire (either natural or planned) is acceptable in all wild and scenic river areas to provide for better wildlife habitat or to restore conditions within the natural range of variability. Some activities or infrastructure may be limited (e.g., roads, vegetation management, minerals) or restricted (e.g., hydroelectric power, utility corridors) within wild and scenic river areas to maintain, protect, or enhance river characteristics and outstandingly remarkable values on eligible river segments.

The designation of these river corridors as wild and scenic may result in increased public interest and awareness of river resources, especially in the arid Southwest, leading to increased visitation and potential impacts to the area. Conversely, increased visitation to wild and scenic river areas could have some

[39] The geographic area generally encompassed within one-quarter mile on either side of a river studied for eligibility or suitability that contains the river and its outstandingly remarkable values.
[40] Flowing in a natural condition without impoundment, diversion, straightening, riprapping, or other modification of the waterway.
[41] For effects of eligible wild and scenic rivers on these resources, see the appropriate sections within chapter 3 of this document.

detrimental ecological impacts, such as ground disturbance, increased trash or discarded items, nonnative species introductions or spread, reduced fish populations (through increased fishing pressure), or aquatic habitat degradation. However, because there are no known studies comparing river use levels and effects before and after wild and scenic river designation, any difference in localized resource damage from increased recreation after wild and scenic river designation cannot be confirmed.

As populations increase and more people visit the Tonto National Forest, the value of managing these areas in their relatively natural condition may increase user satisfaction and contribute to the increased wellbeing of visitors from spending time in these special areas. The peacefulness of the more untrammeled wild and scenic areas could reduce stress and allow for sightseeing or wildlife viewing opportunities, while recreation segments provide increased opportunity for sport and leisure activities. An increase in visitation to wild and scenic river areas could generate increased economic revenue within the surrounding communities through the sale of food, lodging, bait and tackle, guide services, or other river-based revenue sources.

If eligible wild and scenic rivers are designated by Congress, it will provide a higher protection for: safeguarding clean water; preventing activities that would significantly harm the river's character and benefits; prohibiting new dams or damaging water projects; and protecting land along the river with a quarter-mile protective buffer along the wild and scenic river flowing through publicly owned lands (American Rivers 2017). A management plan with input from local landowners and other stakeholders ensures a shared vision on how to preserve the special character of the river. The designation can also reduce the impacts of floods; preserve some important ecosystems; enable native plants and animals to thrive; preserve the cultures of communities who once lived by the river; provide exceptional recreation and wildlife viewing; and improve understanding of the evolution of the planet by preserving special rock and geologic formations. Furthermore, it may preserve the quality of life of adjacent landowners, protect and/or increase private property value, and boost local economy by generating income through the growth of recreation and tourism activities.

Effects of Alternative A

The 1985 forest plan includes little forestwide management direction for eligible wild and scenic rivers. Thus, management of eligible wild and scenic rivers would defer to Forest Service Handbook 1909.12, Chapter 84.3 – Interim Protection Measures for Eligible or Suitable Rivers for directives in alternative A. In the instances an eligible segment overlaps with a different management area, interim management guidelines for each preliminary river classification do not always match the directives for a particular management area, eligible wild and scenic river corridors are managed by the more restrictive management area or river corridor direction and are supplemented by the proposed wild and scenic river comprehensive management plan direction, especially with regard to identified outstandingly remarkable values. By managing for the most restrictive management directives, the criteria guiding the eligibility (or designation) of wild and scenic rivers would be upheld and the benefits and effects of the alternatives described above would remain applicable.

The lack of climate change direction in the 1985 plan would fail to guide future management in addressing climate effects on wild, scenic, and recreational rivers, which might ultimately degrade the character of water resources and riparian areas. Warmer temperatures and drier conditions could cause streams or segments eligible for wild, scenic, and recreational river designation to dry up, making them no longer suitable for recreational uses such as boating and sport fishing. Intense flooding caused by extreme storms could significantly impair the water quality of streams, making them unsuitable for water-contact recreation. In the absence of direction and appropriate management responses to climate changed induced events, the visitor recreational experience on wild, scenic, and recreational rivers would be diminished.

Effects of All Action Alternatives

For alternatives B, C, and D, all eligible river corridors are included in the eligible wild and scenic rivers management area. Similar to alternative A, the wild and scenic river management area may overlap other designated areas or management areas with more restrictive management. Regardless of which management area or designated area each eligible river overlays, the river characteristics and outstandingly remarkable values would be protected through application of the plan components and interim management guidelines given in the Forest Service Handbook 1909.12-80. By managing for the most restrictive management directives, the criteria guiding the eligibility (or designation) of wild and scenic rivers would be upheld and the benefits and effects of the alternatives described in effects of all alternatives would remain applicable. Therefore, the indirect effects of management of other forest resources (e.g., grazing, vegetation, forest products, wildlife, etc.) are not expected to affect eligible wild and scenic rivers.

Effects of Alternative B and C

Under alternative B and alternative C, eligible scenic and wild classification river corridors would be managed under the more restrictive guidelines for recommended wilderness management, where the two overlap. Following the guidelines of recommended wilderness management in eligible wild and scenic river corridors would provide greater protection to the river characteristics and outstandingly remarkable values through nonmotorized recreational use emphasis, no suitability for timber production, and very high scenic integrity objectives that are not protections within river corridors. The limited access into corridors where they overlap would result in a higher likelihood that these resources are enhanced, rather than simply protected, and enjoyed for future generations.

Designated and Recommended Research Natural Areas and Botanical Areas

Affected Environment

This section includes designated and recommended research natural areas and botanical areas (table 204). These areas are managed to maintain or enhance the characteristics in which they are recommended. Research natural areas are part of a national network of ecological areas designated in perpetuity for research and education and/or to maintain biological diversity on National Forest System lands. Research natural areas are principally for non-manipulative research, observation, and study. Any research natural areas within existing wilderness are managed in accordance with agency policy on retaining wilderness character. A botanical area is an area that contains plant specimens, plant groups, or plant communities that are significant because of their form, color, occurrence, habitat, location, life history, arrangement, ecology, rarity, or other features.

Table 205. Designated and recommended research natural areas and botanical areas on Tonto National Forest

Area Name	Classification	Acres	Ranger District
Buckhorn Mountain	designated research natural area	2,801	Tonto Basin
Bush Highway	designated research natural area	516	Mesa
Dutchwoman Butte	recommended research natural area	86	Tonto Basin
Fossil Springs	recommended botanical area	9	Payson

Area Name	Classification	Acres	Ranger District
Haufer Wash	designated research natural area	751	Tonto Basin
Horseshoe	recommended botanical area	3,590	Cave Creek
Little Green Valley Fen	recommended botanical area	21	Payson
Mesquite Wash	recommended botanical area	10	Mesa
Picketpost Mountain	recommended research natural area	1,261	Globe
Three Bar	recommended research natural area	22,920	Tonto Basin
Upper Forks Parker Creek	recommended research natural area	1,441	Pleasant Valley

There are three designated research natural areas on the Tonto National Forest: Buckhorn Mountain, Bush Highway, and Haufer Wash. There are four recommended research natural areas: Dutchwoman Butte, Picketpost Mountain, Three Bar, and Upper Forks Parker Creek. There are four recommended botanical areas: Mesquite Wash, Horseshoe, Fossil Springs, and Little Green Valley Fen.

Buckhorn Mountain Designated Research Natural Area

Buckhorn Mountain Research Natural area lies in the vicinity of Four Peaks in the southern portion of the Mazatzal Mountains in the Tonto Basin Ranger District. Approximately two-thirds of the research area is within Four Peaks Wilderness area (see the Designated Wilderness section for additional plan direction). Lands around Buckhorn Mountain in the Four Peaks vicinity of the Mazatzal Mountains are extensively mantled by dense Arizona chaparral vegetation. A variety of chaparral plant associations exists on the steep, rugged topography of the northeasterly trending drainages of Buckhorn Mountain. This research area was established to provide a minimally disturbed example of Arizona chaparral. Two watersheds (Baldy Canyon and upper Buckhorn Creek) are present in the area and in the event of fire, it is improbable that both watersheds would be equally burned, and thus researchers and managers would have a good opportunity to study fire succession and fire physiology of different chaparral species. The area also serves as an unmanipulated baseline to compare against grassland conversion experiments (prescribed fire) conducted just outside the research natural area.

Bush Highway Designated Research Natural Area

The Bush Highway Research Natural Area is located in the Mesa Ranger District, approximately 1.5 miles north of Saguaro Lake on the Salt River. The old Bush Highway traverses the west side of the area. The research natural area is typical of the palo verde-cactus shrub type. The research natural area represents a benchmark example of the Sonoran desert ecosystem at the warmer end of the climate gradient (hyperthermic) and serves as a baseline reference area. The area also compliments the recommended Picketpost Mountain research natural area that represents the Sonoran desert ecosystem at different climate regime (thermic; not as warm as hyperthermic).

Dutchwoman Butte Recommended Research Natural Area

The Dutchwoman Butte recommended research natural area is located in the Tonto Basin Ranger District, seven miles north of Roosevelt, Arizona. The 86-acre area is an isolated butte that contains a relict semi-desert grassland community that has not been grazed by domestic livestock, largely due to the steep topography. The vegetation has elements of higher elevation woodlands (e.g., the presence of turbinella oak; *Quercus turbinella*) but is predominately more similar to that of semi-arid grasslands with a climate at the extreme cool/moist end of the semi-arid grassland gradient. The area serves as a valuable reference area in that it represents one of the very few semi-arid grasslands that have not been impacted by domestic livestock grazing and it can be used to assess the impacts that have occurred on managed sites with similar ecosystems.

Fossil Springs Recommended Botanical Area

The Fossil Springs recommended botanical area is located in the Payson Ranger District. The area serves as a benchmark example of a rare spring ecosystem in Arizona – one with a highly diverse riparian deciduous forest, a large and complex spring system, and travertine geology. The springs in Fossil Creek are situated in the bottom of a wide, deep canyon. The springs are responsible for the formation of extensive travertine beds about 1 mile long and on-half mile wide. The springs issue from Redwall limestone and as a result contain moderate amounts of dissolved solids, primarily calcium, magnesium, and bicarbonate. The springs and these geologic features produce the “fossilized” appearance of debris that collects at the bottom of the stream bed. The floral diversity is high due to the combination of water, elevation and both north and south facing slopes. The vegetation changes markedly from pine forest to more xeric, lower elevation species as one descends into Fossil Creek Canyon. Luxurious, dense growth of riparian plants are found in the immediate area of the springs. A dense understory of annual and perennial plant species is found throughout the area – over two feet tall in some places. The stream, riparian area, and vegetation also support a high diversity of aquatic and wildlife species.

Haufer Wash Designated Research Natural Area

The Haufer Wash Research Natural Area is located 3.5 miles north of Punkin Center and adjacent to SR 188 in the Tonto Basin Ranger District. The area has important benchmark value because it contains semi-desert grassland and desert scrub vegetation following a half-century of recovery after livestock exclusion. The area was originally established as a range exclusion in the 1930s. The vegetation, soil, landform, and climate of the area is representative of thousands of acres with ongoing livestock management within Tonto Basin, as well as adjacent allotments.

Horseshoe Recommended Botanical Area

The Horseshoe recommended botanical area is located in the Cave Creek Ranger District. The Horseshoe recommended botanical area includes limestone outcrops within the *Larrea tridentata-Canotia holacantha* (creosote and crucifixion thorn) association of the paloverde-mixed cactus series (Brown and Lowe 1982). The boundary for the botanical area was delineated to capture the major limestone outcrops and portions of the surrounding creosote-crucifixion association located along Horseshoe Lake in the Cave Creek Ranger District. There are two subareas – one located at the southwest side of Horseshoe Lake just west of Horseshoe recreation area, and the other subarea is located at the north and northeast side of the lake. The differences in soils and soil chemistry in the area produce striking differences in species composition. The limestone outcrops harbor a number of rare, endemic, sensitive and at-risk plant species including the Arizona cliffrose (*Purshia subintegra*). The only known occurrences of Ripley’s wild buckwheat (*Eriogonum ripleyi*) and Rusby’s milkwort (*Polygala rusbyi*) on the forest are located in this area and they both are northern-region species (from the Colorado Plateau) that are disjunct into the Sonoran Desert (i.e., uncommon in the Sonoran desert). The horseshoe deer vetch (*Lotus mearnsii* var. *equisolensis*) is only found in this area and at the Verde Valley Botanical Area on the Coconino National Forest. For these reasons, the area has high research value and botanical value. The area and management also provides excellent educational opportunities (e.g., university botany fieldtrips and rare plant citizen science projects) and contributes to the management of viable populations of at-risk species.

Little Green Valley Fen Recommended Botanical Area

The Little Green Valley Fen recommended botanical area is located in the Payson Ranger District. The Little Green Valley Fen recommended botanical area serves as a benchmark example of a rare and sensitive wetland meadow with peat soils that are rare in Arizona. Additionally, the alternating layers of peat and gravel (observed in the headcut) reveal the evolutionary sequence of landform processes which has allowed researchers to reconstruct past climate, vegetation, and disturbances. The boundary was delineated to capture the wetland meadow and portions of Green Valley creek. This area includes the wetland and southern portion of Green Valley Creek where the tributary enters the creek from the southeast. The meadow is about 0.25 miles wide but narrows down to a small outlet of less than 100 feet at the southwestern end where Green Valley Creek leaves the meadow. The lower end of the meadow is constantly wet at the lower end and drier at the upper end. The organic layer is about 7 meters thick at the outlet end of the fen. The meadow supports a diversity of grasses, sedges, and wetland herbaceous species. The surrounding vegetation is ponderosa pine oak forest with scattered occurrences of pinyon and juniper.

Mesquite Wash Recommended Botanical Area

The Mesquite Wash recommended botanical area is located along Sycamore Creek in the Mesa Ranger District. The Mesquite Wash recommended botanical area is a unique desert riparian area within Sycamore Creek – rare on the forest and within the state. The boundary was delineated to capture the riparian area, mesquite stands along the northern side of the creek (bounded by the existing pipe rail), and portions of the southern side of the creek where the riparian area transitions into desert scrub. The western extent ends where the channel becomes intermittent along Sycamore Creek. Arizona walnut and willows are abundant along the channel with mesquite occupying the terraces and upper banks. The more or less permanent water source and spring at Mesquite Wash produce a striking level of plant diversity and a stark difference to the surrounding vegetation outside the riparian area. There are also many important birds, other wildlife, and aquatic species in the area. There is high public interest in the area for its botanical values and the area is regularly visited by botany students, botanists, researchers, and recreationists.

Picketpost Mountain Recommended Research Natural Area

The Picketpost Mountain recommended research natural area is located in the Globe Ranger District. The Picketpost Mountain recommended research natural area contains excellent examples of the Sonoran Desert in many of its varied plant community associations on foothill and piedmont topography. The eastern piedmont, bounded by cliffs along Telegraph Canyon and Arnett Creek, represents the Sonoran desert on gentle upland slopes. Stretches of Arnett Creek are included in the area and have perennial flow that supports a riparian gallery forest (which is rare in the state and on the forest). The varied topography and soils around Picketpost Mountain display a number of unique plant communities within a small area and also represents the limiting cold temperature boundary of the saguaro cactus distribution. Arnett Creek and the adjacent uplands serve as excellent benchmark examples for Sonoran desert plant communities and deciduous riparian forests. The area also serves as an important gene pool for Sonoran flora (especially cacti) and fauna, and as a control to study the effects of grazing management (at areas excluded from livestock grazing).

Three Bar Recommended Research Natural Area

The Three Bar recommended research natural area is located in the Tonto Basin Ranger District. The 22,920-acre area abuts the Buckhorn Mountain Research Natural Area and the Four Peaks Wilderness area to the west and extends about five miles to the east towards Roosevelt Lake. The terrain consists mostly of steep slopes and rocky ravines and the dominant ecological response units (ecosystem types) include interior chaparral, Sonoran palo verde-mixed cactus scrub, semi-desert grassland, and some inclusions of deciduous riparian woodlands (mainly Arizona sycamore and Fremont cottonwood). The area has been ungrazed by livestock since the 1940s. The area has high research value and interest from the public. There have been a number of past and ongoing wildlife studies and research in the area. Additionally, the area serves as a valuable reference area in that it contains a variety of ecosystem types that have been ungrazed and can be used to assess the impacts that have occurred on managed sites with similar ecosystems.

Upper Forks Parker Creek Recommended Research Natural Area

The Upper Forks Parker Creek recommended research natural area is located in the Pleasant Valley Ranger District. The Upper Forks Parker Creek recommended research natural area contains excellent examples of canyon bottom forests consisting of mixed broad-leaf riparian forests – ranging from sycamore-walnut-Arizona alder forests near the headquarters to white fir-big-toothed maple forests at higher elevations. Riparian vegetation is present along both upper and lower forks within chaparral and mixed conifer forests on canyon side slopes and summits. The absence of Arizona cypress from the canyon above the headquarters makes this area unique compared to other mixed broad-leaf canyon bottom riparian forests typically found below the Mogollon rim (such as what is commonly found on the Coronado National Forest). There is a long record of research in and around the area and opportunities for continued study or educational use are available in a wide range of biological and environmental fields.

Environmental Effects

Effects Common to All Alternatives

Through agency policy and direction (FSM 4000, 4063 Research Natural Areas) both designated and proposed research natural areas would be protected and maintained in a natural condition for the purpose of conducting non-manipulative research and for fostering education. Similar to research natural areas, botanical areas are a type of special area designation. Botanical areas contain plants, plant groups, or plant communities that are significant because of their form, rarity, or other features.

Inclusion and recommendation of research natural areas and botanical areas increases socio-economic and ecological effects described below. These areas are managed to maintain or enhance the unique characteristics of the area – generally through increased standards and guidelines. For these reasons, ecological conditions are most likely to be maintained and restored and enjoyed by the public. Including these areas in the forest plan not only provides additional resource protection and management emphasis, but also educates the public on the unique ecosystems and botanical values of the forest, increasing user experience and satisfaction (for example, watchable wildlife, botany fieldtrips, promoting natural history studies, and nature photography). These areas also provide important visual components (including hanging gardens and lush and diverse vegetation with various colors) to the landscape, increasing scenic integrity on the forest. Special areas also contribute to the regional biodiversity of rare and unique ecosystems that are managed in perpetuity as special areas.

All recommended and designated research natural areas on the forest are removed from commercial timber harvesting (see the Timber Suitability section). This does not restrict thinning for restoration purposes, but rather removes these acres from the suitable timber base for commercial purposes (saw timber). Therefore, while minor, excluding these areas from commercial timber harvest could lead to less available commercial saw timber for local industries.

Effects of Alternative A

Research natural areas would be managed using the direction in management areas 2E (Picketpost Proposed Research Natural Area), 3E (Bush Highway Research Natural Area), 5F (Upper Forks Parker Creek Proposed Research Natural Area), 6D (Buckhorn Research Natural Area), and 6E (Haufer Wash Research Natural Area), and agency policy. Management direction includes standards for various management activities that would not be appropriate within a research natural area such as:

- there will be no harvest of forest products, including fuelwood and jojoba,
- no surface occupancy for mineral leasing,
- mange rangeland at level a, which excludes the area from livestock grazing, and
- manage dispersed recreation at low intensity – reduced service level.

While the existing forest plan (alternative A) does provide some level of resource protection for designated and recommended research natural areas, the forest plan is silent on other uses and activities (e.g., trail construction, overnight camping, and recreation fires) that could negatively impact conditions of the natural resources, including trampling of vegetation and other important resources for which the area was identified. Therefore, the action alternatives would provide better management direction to address current and foreseeable uses that could negatively impact conditions in these areas.

The overall lack of climate change direction in the existing plan on resources in research natural areas would be similar to those described above for designated wilderness. Plants and animals would be extremely vulnerable to the consequences of atypical temperatures and rainfall patterns, which include drought; increased number and severity of wildfires; increased stress on vegetation, including insect and disease outbreaks; and decreased water yield and availability. Each of these consequences may affect one or more resources within recommended and designated research natural areas, some more than others, depending on location and uses. This may diminish the opportunity for scientists and others who use the natural resources in these areas to study plants and animals.

There are no recommended botanical areas in this alternative, therefore the botanical resources that have been identified on the forest would not have additional management protections on them which could result in these special botanical resources being negatively impacted by high levels of recreation use including trammeling of plants, loss of qualities that make these areas unique, and soil compaction. Additionally, there are a number of rare and federally listed plant species that could be more negatively impacted by this high use without having the additional resource protections special areas would provide.

Effects Common to Alternatives B, C, and D

Alternatives B, C, and D include established research natural areas as designated areas with comprehensive plan components. Plan components emphasize the study of ecosystems and ecological processes, natural settings, and nonmotorized uses. Management direction includes standards for various management activities that would not be appropriate within a research natural area such as stipulating no extraction of common variety minerals, prohibiting vegetation manipulation or removal of forest projects for commercial purposes unless it is necessary to maintain the natural characteristics for which an area was established, prohibiting new trail and road construction or opening closed roads, and prohibiting campfires. Overall, the comprehensive direction would result in more protection and enhancement of the natural features for which a research natural area was established than alternative A.

Effects Common to Alternatives B and C

Alternatives B and C would include all established research natural areas, formerly proposed research natural areas (Upper Forks Parker Creek and Picketpost), plus two additional recommended research natural areas (Dutchwoman Butte and Three Bar) that have prime examples of semi-desert grasslands that are relatively undisturbed. Semi-desert grasslands have been dramatically reduced regionally (from fire suppression, shrub encroachment, livestock grazing, and urban development) and these ecosystems were identified as being poorly represented within the Southwest regional network of research natural areas. These alternatives would also include four recommended botanical areas, three of which (Mesquite Wash, Little Green Valley Fen, and Fossil Springs) represent rare and unique riparian ecosystems that are limited in the Southwest. There would be increased management emphasis and resource protection (through additional standards and guidelines) for rare, endemic, and at-risk plant species (species of conservation concern and federally listed) by recommending the Horseshoe Botanical Area for special area designation.

These areas would all be managed under consistent guidance outlined in the forest plan, which provides further protection and enhancement of the natural features for which a research natural area or botanical area has been recommended. This comprehensive plan management direction includes standards for various management activities that would not be appropriate within a research natural area such as stipulating no extraction of common variety minerals, prohibiting vegetation manipulation or removal of forest projects for commercial purposes unless it is necessary to maintain the natural characteristics for which an area was established, prohibiting new trail and road construction or opening closed roads, and prohibiting campfires.

The inclusion of these recommended areas in alternatives B and C allows for greater protection of important botanical resources and areas of research importance on the Tonto National Forest. Overall, these alternatives would provide the most beneficial effects that come with recommending and including research natural areas and botanical areas. These effects include improved ecological conditions through additional resource protection and management emphasis, increased user experience and satisfaction (e.g., watchable wildlife, botany fieldtrips, promotes natural history studies, nature photography), increased scenic integrity, and contribution to the regional biodiversity of rare and unique ecosystems that are managed in perpetuity as special areas. Additionally, alternatives B and C would include the most areas and greater diversity of wetland and riparian ecosystems (including rare Sonoran desert riparian areas and wetlands, canyon bottom riparian forests, a rare spring ecosystem, and a rare wetland meadow) which would have the greatest effect of contributing to the regional biodiversity of rare and unique riparian areas and wetlands and maintaining riparian conditions compared to alternatives A and D (see the Riparian Areas section).

Effects of Alternative D

Alternative D was also developed from public input to reduce restrictions on user access and permitted uses. Therefore, no recommended research natural areas and botanical areas are included in alternative D. These areas would still receive some level of resource protection through forestwide management direction. However, there is a potential that conditions may not be maintained as well as they could with the resource protections (through additional standards and guidelines) and management emphasis that recommended research natural areas and botanical areas would provide. Therefore, under alternative D there would be the least beneficial effects of contributing to the regional biodiversity of rare and unique ecosystems and maintaining ecological conditions compared to other alternatives. For these reasons, this alternative would have the greatest potential of negative effects that come with not providing these areas with special area management, including degraded conditions from motorized use, increased risk if uncharacteristically severe fire, common variety mineral extraction from sensitive resources), due to the lack of added protections.

For these reasons, this alternative would provide the least beneficial effects that come with recommending and including research natural areas and botanical areas compared to other alternatives. These effects include improved ecological conditions through additional resource protection and management emphasis, increased user experience and satisfaction (e.g., watchable wildlife, botany fieldtrips, promotes natural history studies, nature photography), increased scenic integrity, and contribution to the regional biodiversity of rare and unique ecosystems that are managed in perpetuity as special areas. Recommended research natural areas are excluded from the suitable timber base.

Inventoried Roadless Areas

Affected Environment

Inventoried roadless areas are an administrative designation identified in the 2001 Roadless Area Conservation Rule (36 CFR Part 294). Inventoried roadless areas are relatively undisturbed areas that serve as reference areas to measure the effects of development on other parts of the landscape. Road construction, reconstruction, and timber harvest activities are limited within these areas to sustain the social and ecological roadless characteristics of each area. These activities were selected because they commonly occur on forests and grasslands across the Nation, have the greatest likelihood of altering landscapes, cause significant landscape fragmentation, and result in immediate and long-term loss of roadless characteristics (USDA Forest Service 2000).

In 2000, the Forest Service completed an inventory of National Forest System lands for each forest and grassland that had been inventoried as roadless for planning purposes. This inventory was based on existing forest plans, plan revisions in progress where the agency has established a roadless inventory, or other assessments completed and adopted by the agency, including the Roadless Area Review and Evaluation (RARE) II inventory (USDA Forest Service 2000). These areas became identified as inventoried roadless areas under the 2001 Roadless Area Conservation Rule and are managed to preserve roadless character. As defined by the 2001 Roadless Area Conservation Rule, the following values or features characterize inventoried roadless areas:

1. High quality or undisturbed soil, water, and air;
2. Source of public drinking water;
3. Diversity of plant and animal communities;
4. Habitat for threatened, endangered, candidate, proposed and sensitive species on large areas;
5. Natural appearing landscapes with high or very high scenic integrity;
6. Primitive, semiprimitive nonmotorized and semiprimitive motorized recreation opportunity spectrum classes of dispersed recreation;
7. Reference landscapes;
8. Traditional cultural properties and sacred sites; and
9. Other locally identified unique characteristics.

In an increasingly developed landscape, inventoried roadless areas provide large unfragmented tracts of land. As such, undisturbed landscapes that are important to biological diversity are a supporting ecosystem service of inventoried roadless areas. They provide provisioning services such as clean drinking water and regulating services such as serving as bulwarks against the spread of nonnative invasive plant species. Opportunities for dispersed outdoor recreation, serving as reference areas for study and research, and their high scenic quality are cultural ecosystem services of inventoried roadless areas.

The Tonto National Forest manages thirteen inventoried roadless areas, totaling about 264,876 acres (table 206). Inventoried roadless areas contribute to ecological sustainability by providing clean drinking water and by functioning as biological strongholds for populations of threatened and endangered species. They provide large, relatively undisturbed landscapes that are important to biological diversity and the long-term survival of many at-risk species. They also serve as barriers against the spread of nonnative invasive plant species and provide reference areas for study and research. Inventoried roadless areas also contribute to social sustainability by providing opportunities for dispersed recreation, opportunities that diminish as open space and natural settings area developed elsewhere.

Table 206. Inventoried roadless areas on the Tonto National Forest

Inventoried Roadless Area	Inventoried Acreage	Adjusted Acreage from 1984 Reevaluation	Location	Description
Arnold Mesa Roadless Area	not available	249	Cave Creek Ranger District, Yavapai County. Bordered on the north, east and south by Cedar Bench Wilderness, Pine Mountain Wilderness Contiguous Roadless Area and Pine Mountain Wilderness.	Topography is similar to the wilderness areas it is between pinion and juniper trees, hot dry mesas, scant water, desert mountains, Saguaro cactus and rugged canyons.
Black Cross Roadless Area	6,290	6,285	Mesa Ranger District, Maricopa County. Bounded by Canyon Lake on the north and west, State Highway 88 (Apache Trail) on the south and separated from the Horse Mesa Roadless Area by a road/powerline to the east. The Superstition Contiguous Roadless Area is just to the south, and the Superstition Wilderness area is two miles south of the inventoried roadless area.	Topography is very rugged, there are no system trails. Vegetation is Sonoran desert scrub with very small areas of riparian vegetation. Recreation use is extremely light; this area serves as a visual backdrop for Canyon Lake. Tortilla Campground and Tortilla Flat Commercial Public Service Site are located within 0.5 miles of the inventoried roadless area.
Boulder Roadless Area	45,000	47,600	Tonto Basin and Mesa Ranger Districts. Maricopa and Gila counties. Approximately1.5 miles west of Punkin Center. The area is bounded to the north by the Mt Ord summit zone, to the south by the Four Peaks Roadless Area, to the east by State Highway 188, and on the west by State Highway 87.	Topography is dominated by the crest of the Mazatzal mountain range. There are five system trails (17 miles). Vegetation is Interior chaparral and Sonoran desert scrub. Recreation use is light, dispersed hunting and OHV use.
Cherry Creek Roadless Area	12,130	10,789	Pleasant Valley Ranger District, Gila County. The area is located approximately 10 miles south of Young, AZ. The Cherry Creek Road (203) runs parallel to the south and west sides, and the Sierra Ancha Wilderness and Sierra Ancha Contiguous Roadless Area are to the west.	Topography includes high cliffs and steep canyons with isolated benches and small mesas. The area is very rugged and remote, there are no system trails. Vegetation is representative of southwestern mountain ranges rising from the desert. Recreation use is moderate, hunting, sightseeing and OHV use.
Goldfield Roadless Area	16,930	15,400	Mesa Ranger District. Maricopa County. State Highway 88 (Apache Trail) borders the area to the east, Usery Pass Road (207) is approximately 2 miles to the west. Bush Highway and the Salt River are to the northwest, and Saguaro Lake forms the northern border.	Topography is very rugged with mountains jutting dramatically off the desert floor. There are no system trails. Vegetation is Sonoran Desert scrub. Recreation use is extremely light. The area serves as a backdrop for the popular Saguaro Lake.

Inventoried Roadless Area	Inventoried Acreage	Adjusted Acreage from 1984 Reevaluation	Location	Description
Hellsgate Roadless Area	30,400	39,290	Payson Ranger District. Gila County. Access to the North boundary is from State Highway 260 to Forest Road 405A where Trail 37 enters the northern boundary. Bull Tank Canyon is along the northeast boundary. Access to the southwest boundary is from Forest Road 371. Mogollon Rim is to the north, the town of Gisela is approximately three miles to the south, Young is approximately ten miles to the east and Payson is approximately nine miles to the west.	Topography is very broken terrain of moderate to steep slopes and rocky ridges. There is one system trail. Vegetation is Ponderosa pine in the drainage bottoms and on north facing slopes with Pinyon pine and one-seed juniper dominant elsewhere. Recreation use is nonmotorized and fairly light.
Horse Mesa Roadless Area	10,450	10,334	Mesa and Tonto Basin Ranger District. Maricopa County. State Highway 88 (Apache Trail forms the southern boundary and Apache Lake is along the northern boundary. The Superstition Contiguous Roadless area is south of the area, separated by Apache Trail.	Topography is very rugged, dominated by Horse Mesa, a high, inaccessible bench, and Fish Creek Canyon, a deep and spectacular canyon that flows north out of the Superstition Wilderness area. There are no system trails. Vegetation is dominated by Sonoran desert-scrub. Recreation use is extremely light.
Lime Creek Roadless Area	43,050	38,510	Cave Creek Ranger District. Maricopa and Yavapai counties, approximately 40 miles north of Phoenix, just west of Horseshoe Lake.	Topography includes canyons, grass-covered ridgetops, mountain peaks and flat volcanic mesas. There are no system trails. Vegetation includes Sonoran desert, semi-desert grassland, chaparral and juniper. Recreation use is extremely light.
Mazatzal Roadless Area	83,700	55,068	Cave Creek Ranger District. Gila and Yavapai counties. Three separate parcels contiguous with the Mazatzal Wilderness area, one parallels the northeast boundary of the wilderness area near Pine Creek (approximately eight miles west of Payson), a large portion is to the north and west of the wilderness (two to four miles south of Pine and Strawberry), and a small parcel is adjacent to the southwest corner of the wilderness.	Topography varies from extremely steep canyons to rolling desert. The Verde river flows through the area. There are 25 miles of system trails. Vegetation includes Sonoran Desert-scrub, semi-desert grasslands, Interior chaparral and Great Basin Conifer Woodland. The area is popular for recreation including hiking, horseback riding, photography, hunting and fishing.
Salome Roadless Area	30,400	21,358	Tonto Basin Ranger District, Gila County. Located approximately 21 miles south of Young and approximately five miles north of Roosevelt Lake. The McFadden Peak fire lookout tower is approximately two and a half miles to the northeast and the small Rose Creek campground is approximately two and a half miles to the east.	Topography is extremely rugged with steep slopes, outcroppings of bedrock and precipitous bluffs. There are two system trails. Vegetation ranges from semi-desert to chaparral with occasional pines at higher elevations and riparian vegetation along Salome stream. Recreation use is extremely light.

Inventoried Roadless Area	Inventoried Acreage	Adjusted Acreage from 1984 Reevaluation	Location	Description
Picacho Roadless Area	48,490	5,866	The Salt River and Fort Apache Indian Reservation form the northern boundary of the Picacho area.	The Picacho area contains a portion of the Salt River Canyon. Vegetation is Interior chaparral. Recreational use is river oriented, kayaking and rafting on the popular Salt River.
Pine Mountain Wilderness Contiguous Roadless Area	not available	6518	Cave Creek Ranger District. Yavapai County. This Roadless area is divided into two pieces the northern piece is bordered on the north, west and south by Cedar Bench Wilderness, Arnold Mesa Roadless Area and Pine Mountain Wilderness. The southern piece spreads from the southwestern point of the Pine Mountain Wilderness east, west and south.	The topography is similar to Arnold Mesa: pinion and juniper trees, hot dry mesas, scant water, desert mountains, Saguaro cactus and rugged canyons. The southern piece is mostly flat with more hills and Saguaros than mountains and trees.
Sierra Ancha Contiguous Roadless Area	11,520	7,609	Pleasant Valley Ranger District, Gila County. Located approximately 12 miles south of Young. State Highway 288 parallels the west side. Access to the north and east sides on Forest Road 203 (Cherry Creek Road). The Cherry Creek Roadless Area is to the north-northeast separated by a road corridor.	Topography is dominated by high cliffs and abrupt changes in elevation, precipitous box canyons run eastward into Cherry Creek. Vegetation is representative of Southwestern mountain ranges which rise from the desert floor. Nonmotorized recreation use is light but increasing. The Sierra Ancha Wilderness and adjacent roadless area is one of the most picturesque in the Southwest.
Tonto Total	338,360	264,876	Not applicable	Not applicable

Environmental Effects

Effects Common to All Alternatives

No new inventoried roadless areas are proposed for any alternative. Under all alternatives, inventoried roadless areas would be managed in accordance with current regulation and policy. Activities within inventoried roadless areas must follow Forest Service policy on road construction and tree cutting, which is consistent with national Forest Service policy on preserving their roadless character. Inventoried roadless areas would be managed to protect their roadless character and the values and features that characterize those areas.

Under all alternatives inventoried roadless areas would continue to be reference areas to measure the effects of development on other parts of the landscape and a variety of ecosystem services. This includes clean drinking water and function as biological strongholds for populations of threatened and endangered species. They would provide large, relatively undisturbed landscapes that are important to biological diversity. Inventoried roadless areas would continue to provide opportunities for dispersed outdoor recreation as those opportunities diminish elsewhere as open space and natural settings are developed. They also serve as bulwarks against the spread of nonnative invasive plant species and provide reference areas for study and research.

Effects of Alternative A

Alternative A does not include specific plan components for inventoried roadless areas and provides the least direction for roadless areas management of all the alternatives. Emphasis for management in alternative A would continue under the management areas that inventoried roadless areas occupy and the 2001 Roadless Area Conservation Rule. Although a management area's emphasis may differ (such as timber emphasis), Forest Service regulation and policy would provide management guidance for inventoried roadless areas to protect roadless character, therefore there are no effects specific to alternative A.

Effects Common to All Action Alternatives

Inventoried roadless areas are included in the forest plan as designated areas with specific plan components specific to these areas to protect roadless character in alternatives B, C, and D. According to plan components, inventoried roadless areas should be managed for primitive, semiprimitive nonmotorized, and semiprimitive motorized recreation opportunity spectrum settings and consistent with the appropriate scenic integrity objectives of the area. Under any of these alternatives, inventoried roadless areas would also be managed under the emphasis of the management areas or geographic areas they occupy, the designated area's plan components, and the 2001 Roadless Area Conservation Rule. Where designated areas, geographic areas, and management areas overlap, the most restrictive plan components apply. Overall, inventoried roadless area plan components seek to preserve natural settings and roadless character providing large, relatively undisturbed landscapes across the forest.

Each of these alternatives would also include eligible wild and scenic rivers that may overlap with inventoried roadless areas. Plan components for this management area complements the management for roadless characteristics.

Alternatives B, C, and D provide more comprehensive direction than alternative A, resulting in the best management and protection of inventoried roadless areas and the associated effects of maintaining roadless areas. Therefore, under the action alternatives, inventoried roadless areas would continue to be reference areas to measure the effects of development on other parts of the landscape and a variety of ecosystem services such as undisturbed landscapes that are important to biological diversity, clean drinking water, and opportunities for dispersed outdoor recreation, reference areas for study and research, and high scenic quality.

Effects Common to Alternative B and C

Alternatives B and C include areas where inventoried roadless areas overlap with recommended wilderness areas and would be managed under the more restrictive guidelines specific to recommended wilderness management. Following standards and guidelines for recommended wilderness management would protect roadless characteristics present in overlapping areas, likely resulting in the highest quality roadless character due to the more restrictive management direction to protect or enhance wilderness characteristics[42].

National Trails

Affected Environment

Congress passed the National Trails System Act in 1968. The Act authorized creation of a national trail system comprised of national scenic trails, national historic trails, and national recreation trails. The Tonto National Forest administers four national trails: Highline Trail, Six Shooter Canyon Trail, Great Western National Millennium Trail, and the Arizona National Scenic Trail.

As a designated trail administering agency, the Forest Service is responsible for trail-wide coordination such as: coordination among and between agencies and partner organizations in planning, marking, certification, resource preservation and protection, interpretation, cooperative and interagency agreements; and financial assistance to other cooperating government agencies, landowners, interest groups, and individuals (USDI 2017).

Site-specific trail management is the responsibility of the Federal, State or local government agency or private entity that manages or owns the lands the trail crosses. Trail management includes tasks such as inventorying of resources and mapping, planning and development of trail segments or sites, compliance, provision of appropriate public access, site interpretation, trail maintenance, marking, resource preservation and protection, viewshed protection, and management of visitor use.

Highline National Recreation Trail

The Highline National Recreation Trail (50 miles), established in 1870, was used to travel between homesteads and to attend school in Pine. Famous Arizona historical figures Zane Grey and Babe Haught used the trail while hunting. The trail runs through the northern edge of the Tonto National Forest on the Payson Ranger district. The trail along the Mogollon rim has steep, rocky terrain with spectacular views, canyons, and brushy hills. The portion of the Highline Trail from Washington Park Trailhead to Pine Trailhead is also designated as part of the Arizona National Scenic Trail.

Six Shooter Canyon National Recreation Trail

The Six Shooter Canyon Trail (6 miles), designated in 1979 in the Pinal Mountains, is a challenging, beautiful trail climbing through several life zones as it rises some 3,000 feet in six miles with views of the Miami/Globe area. Access to this trail is approximately 6 miles south of Globe from the Ice House Civilian Conservation Corps trailhead, or the Ferndell Trailhead. Six Shooter Canyon National Recreation

[42] Effects of the presence of recommended wilderness areas can be found in the Recommended Wilderness Areas section.

Trail is home to the national champion Canyon Maple tree. These 2 national recreation trails offer spectacular views and high-quality recreation opportunities.

Arizona National Scenic Trail

The Arizona National Scenic Trail stretches over 800 miles across Arizona from Mexico to the Utah border, showcasing the state's diverse vegetation, wildlife, wilderness and scenery, and providing unparalleled opportunities for hikers, mountain bikers, equestrians, and other trail users. The Omnibus Public Land Management Act of 2009 (P.L. 111-11) amended the National Trails System Act (P.L. 90-543) to designate the Arizona Trail as a national scenic trail. The Arizona National Scenic Trail corridor is defined as approximately one-half mile either side of the centerline of the trail. The Tonto National Forest manages about 200 miles of the Arizona National Scenic Trail on the Globe, Mesa, Tonto Basin, and Payson Ranger Districts.

Environmental Effects

Effects Common to All Alternatives

No new nationally designated trails are proposed in any alternative. The forest plan, along with the comprehensive plan for the Arizona National Scenic Trail, would guide management for that trail under all alternatives, ensuring the coordination and preservation of the trail work is being accomplished. Establishment reports for the other National Trails would continue to guide management under all alternatives. The current nationally designated trails would continue to be managed to protect the values for which they were designated and provide opportunities to view natural features and scenery, recreational opportunities in a variety of recreation opportunity spectrum settings, and public use and enjoyment of historic routes and associated historic remnants (NTMA-DC-03). Following management guidelines for national trails as outlined in the comprehensive plan(s) would also improve other forest resource conditions such as reducing soil compaction by adequately signing designated routes, reducing or preventing damages to cultural resources by re-routing trails away from known sites, and reducing impacts to riparian habitats by providing public education and signs about recreational use near water.

Effects Common to Alternative A

Alternative A has no additional direction in the plan to guide the management of National Trails on the Tonto National Forest. As stated above, they will be managed to ensure their values are protected according to either a comprehensive plan (Arizona National Scenic Trail) or the establishment report for the specific trail. There will be no effects to national trails in this alternative.

Effects Common to All Action Alternatives

Alternatives B, C, and D provide direction to maintain or develop a comprehensive plan to guide how the forest intends to manage all its national trails. As many of the trails extend beyond the forest boundaries, this direction articulates how to manage the segments of trail within the forest boundaries to further protect the values for which they were designated. This additional management direction would lead to greater protection of the trail's values than in alternative A, because the standards and guidelines restrict non-conforming uses, prohibit the sale and extraction of common variety minerals within trail corridors, protect scenic values along trails, and enhance economic values to nearby communities. This can lead to improved user satisfaction rates and higher values and perception of the forest by local communities. This would also help achieve desired conditions related to reducing user conflicts (NTMA-DC-02 and REC-DC-07).

Significant Caves

Affected Environment

Specific to caves, the Federal Cave Resources Protection Act of 1988 (16 U.S.C. § 4301 et seq.) directs the secretaries of the Department of the Interior and the Department of Agriculture to inventory and list significant caves on federal lands. This act recognizes that significant caves are an invaluable and irreplaceable part of our natural heritage, and that caves may be threatened by improper use and increased recreational demand. The purpose of the act is to secure and protect significant caves on Federal land for the benefit and enjoyment of all people while fostering increased cooperation and information exchange among those who use caves for scientific, educational, or recreational purposes. The Federal Cave Resources Protection Act also specifically addresses confidentiality of information regarding the nature and location of caves to ensure their protection, including exemptions for cave location information from the Freedom of Information Act.

The Tonto National Forest contains many significant caves and karst resources. The Federal Cave Resources Protection Act of 1988 (16 U.S.C. 4301-4309; 102 Stat. 4546) defines a significant cave as a cave located on National Forest System lands that has been evaluated and shown to possess features, characteristics, values, or opportunities in one or more of the following resource areas: biota; cultural; geologic-mineralogic-paleontologic; hydrologic; recreational; or educational-scientific for scientific, educational or recreational purposes; and which has been designated “significant” by the forest supervisor. The Forest Service implementation regulations for the Federal Cave Resources Protection Act establishes rules for determination of cave significance (36 CFR §290.3).

Caves and karst resources require special management because they support critical groundwater systems and unique biological communities. They also provide information about climate change, human history, paleontological resources, and minerals. The Forest Service manages caves and karst resources in keeping with the 1988 Federal Cave Resources Protection Act and in accordance with the multiple use mission of the agency.

Environmental Effects

Effects Common to All Alternatives

Under all alternatives caves determined to be significant will be governed under provisions of the Federal Cave Resources Protection Act with an objective to secure, protect, and preserve significant caves. This would result in the perpetual use, enjoyment, and benefit of all people, and foster increased cooperation and exchange of information with those who utilize caves for scientific, educational, or recreational purposes. Regardless of alternative, the plan direction would allow for the preservation of these resources on the forest over the life of the plan. The effects of protection of these areas would be consistent with the effects described in the Caves and Karst section of this document.

Lakes and Rivers Management Area

Affected Environment

The Lakes and Rivers Management Area consists of the areas 0.25 miles around Roosevelt Lake, Apache Lake, Canyon Lake, Saguaro Lake, Horseshoe Lake, Bartlett Lake, the Lower Verde River, and the Lower Salt River. Four Peaks Wilderness and Three Bar Recommended Research Natural Area are not included in this management area. It provides additional guidance in order to sustain and promote the high-use and enhanced recreation in the area.

The lakes provide recreation opportunities such as boating, fishing, picnicking, swimming, and camping. The Lower Salt River provides opportunities for tubing, fishing, picnicking, rafting, kayaking and can attract 7,000 recreationists on a busy day. The Lower Verde River provides swimming, picnicking, and kayaking opportunities. Most access and facilities in these areas are highly developed including campgrounds, picnic sites, boat launches, fishing piers, and paved parking lots. These areas are the closest water-based recreation opportunities on the forest to the Phoenix Metropolitan area. Demands for water-based recreation are high in the summer months when the weather reaches extreme temperatures in the desert.

Fees are charged at most developed recreation sites in this area under the Federal Land Recreation Enhancement Act. Fees have been charged here since 1996. The current fee system is a combination of off-site vender sales and on-site fee machine sales. There are many special use permits issued for marinas, resorts, and shuttle services that provide additional recreation opportunities and services to forest visitors.

Much of the land around the lakes and rivers within this management area is withdrawn from “entry” for irrigation purposes. These “Reclamation Withdrawals” restrict the ability to occupy, or use the land (e.g., mining and homesteading) in a way that would conflict with the construction, operation or maintenance of current or future Reclamation projects. In reference to Reclamation Withdrawals on National Forests Section 3, Part 33 of the Reclamation Act of 1902 (Chap. 1093, 32 STAT. 388) states “Reclamation withdrawals within the national forests are dominant, but until needed by the Reclamation Service, the lands will remain for administrative and protection purposes under control and direction of the Forest Service.”

Environmental Effects

Effects Common to All Alternatives

Visitation levels vary from year to year based on the local economy, availability of water-based recreation equipment locally, local recreation trends and changes in technologies, water levels after dam release, and water conditions from snowmelt. As recreation trends change and public demands increase for certain activities, management will need to adjust to accommodate high levels of use and necessary resource protection. For example, if the trend for kayaking and stand-up paddleboarding continues to increase, the need for water access ramps, trailer parking, and courtesy docks may increase. These infrastructure additions would help decrease soil erosion from poor walkways, decrease litter in waterbodies from lost or “tipped” watercraft during launching, and increase user satisfaction by accommodating larger vehicles in parking lots. Alternatives B and D would best address these needs by including this management area and having desired conditions such as “this area provides diverse recreation opportunities that are enhanced by facilities, access, and unique services” (LRMA-DC-01). Alternatives A and C do not include the management area, and would therefore not be as effective at meeting this and other recreational desired conditions, such as “Recreation on the forest is sustainable and adapts to the latest science, technology, and best management practices when implementing new projects and updating or upgrading existing infrastructure” (REC-DC-03). The surface water supply in many of the watersheds that intersect the Lakes and Rivers Management Area are of high risk of experiencing vegetative change (USDA Forest Service 2018d). This change has the potential to impact future water supply that could lead to an impact on recreation opportunities in the Lakes and Rivers Management Area.

A portion of the Salt River Horse Management Area is within part of the area identified for the Lakes and Rivers Management Area. Regardless of alternative, horses will be managed in and around these busy recreation sites (specifically near the Lower Salt River and Saguaro Lake) unless conditions change based on Arizona Department of Agriculture’s management plan for the Salt River Horses. As long as the horses reside within these recreation areas, conflicts will exist between horses and recreationists, and will continue to grow as recreation demands and/or the herd size grows. See the Salt River Horse Management Area section for more information.

Effects Common to Alternatives A and C

The Lakes and Rivers Management Area is not included in alternative A or alternative C. The land surrounding the lakes and rivers which has been identified as the corridor for the Lakes and Rivers Management Area will be managed the same as the general forest, therefore effects to these areas from other resources would be consistent with potential forest wide impacts described in the resource sections above.

These alternatives would not provide additional guidance on the management of high-use recreation around the lakes and rivers on the Tonto National Forest. The absence of this management area within the Tonto National Forest can lead to multiple use conflicts on the forest, specifically between different types of recreationalists (e.g., target shooters and hikers). Additionally, plan components limit permitted livestock grazing (LRMA-G-05) within this area except where they can be prevented from accessing the rivers and lakes. Alternatives A and C does not address the conflicts between grazing and recreational uses, and it would continue and potentially increase as recreational demands increase over time. With the high level of recreation in this area, the lack of management direction specifically tailored to the type of use around the lakes and rivers could result in an increase of concentrated use[43] that results in soil erosion and compaction, vegetation trampling, increased spread of invasive species, degraded watershed conditions, and low user satisfaction rates.

Effects Common to Alternatives B and D

The Lakes And Rivers Management Area is included in alternatives B and D. There is additional guidance to sustain and promote the high-use and enhanced recreation that these areas provide, which is supported by the visitor impact studies (Marion 2013)[44] that showed one of the most effective management solutions to address visitor impacts is to limit types of use with higher impacts to specific areas.

The plan direction for this area includes additional restrictions on recreational shooting, vehicle use off designated routes, and some restrictions on livestock grazing in order to protect the recreational values identified in the area. Additionally, while the natural resources will be managed to be adaptable to disturbances (LRMA-DC-05) vegetation treatments in this area focus more on complimenting or enhancing the recreational opportunities rather than ecosystem health. These alternatives allow for a reduction in conflict of multiple uses within these areas and increased level of public safety with the identified management priorities.

The Lakes and Rivers Management Area addresses resource conditions such as soil erosion and compaction, vegetation trampling, and watershed conditions through the desired condition “Natural resources…are adaptable to disturbances” (LRMA-DC-05). Having this management area provides an opportunity for recreation management to address issues and high-use impacts directly and early, rather than indirectly and reactively. Poor resource conditions may be prevented or mitigated through developed recreation features and infrastructure such as concrete boat ramps, paved parking lots with boundaries outlined by concrete curbs, designated and monitored staging areas when carrying capacities are met, and restroom facilities and garbage collection bins in visible, high-traffic locations. The difference within this area as compared to forest wide management of our vegetation is that, for the most part, vegetation would

[43] Effects of concentrated use on forest resources can be found in the recreation section of this document.
[44] See the Affected Environment in the Developed Recreation section.

be managed to compliment or enhance recreation opportunities in this management area (e.g., remove nonnative reeds at river access points, utilize native trees and brush for bank stabilization in developed areas) (LRMA-G-03 and LRMA-G-04). These features can improve visitor experiences and improve the local recreation economy through sales for a diverse set of recreation opportunities.

Saguaro Wild Burro Management Area

Affected Environment

The Tonto National Forest contains one wild burro territory established under the Wild Free-Roaming Horses and Burros Act of 1971. The Saguaro Wild Burro Management Area covers 27,092 acres, which includes the 4,180 acres of the designated Saguaro Wild Burro Territory. The Saguaro Wild Burro Management Area is located within the Sunflower grazing allotment, with the majority located in the Four Peaks Wilderness. Burros have not been known to be present in the territory or the larger management area since the early 1990s.

Environmental Effects

Effects Common to Alternative A

Alternative A provides direction stating that the Saguaro Wild Burro Management Area will be managed for a herd size of 15 animals over their entire established range. Plan components would ensure that if burros were present in the area, the ecological conditions of the area would be preserved, and the population would not result in effects such as over grazing and trampling of vegetation.

Since the establishment of this plan, the burro territory has become inactive. There are also no Saguaro Wild Burros in the management area. Any burros that enter the area are not protected under the Wild Horse and Burro Act and would be removed. The absence of burros results in no effect of management on this landscape.

Effects Common to All Action Alternatives

All of the action alternatives include a desired condition that states the Saguaro Wild Burro territory and management area are unoccupied by burros (SWBMA-DC-01) and a standard that the Saguaro Burro territory and Saguaro Wild Burro Management Area shall continue to be managed for zero burros (SWBMA-S-01). Because there are not currently burros in this area, and burros would be removed if found in the area (SWBMA-S-02), there are not any effects of managing the area based on these plan components.

Salt River Horse Management Area

The Salt River Horse Management Area is roughly 21,357 acres in size and encompasses the Goldfield and Bulldog range allotments on both sides of the lower Salt River within the Mesa Ranger District. The Salt River Horse Management Area was created to identify an area the Salt River Horse herd may use on the Tonto National Forest where slight deviation in forest-wide management might occur. This management area has been created as a response to public comments about the Salt River Horses.

The Salt River horse herd includes horses that live in and around the Lower Salt River in the Tonto National Forest and that do not have a brand or other mark that indicates ownership (Arizona Revised Statute 3-1491). The Salt River horse herd typically inhabits an area within the Mesa Ranger District along the lower Salt River and near the northwest shores of Saguaro Lake. A horse survey on March 30, 2017, reported a population of 418 horses residing within the current location of the Salt River Horse

Management Area. Currently, the Salt River horse herd is able to travel freely on the Tonto National Forest, therefore the affected environment is subject to a much larger population of horses that can move back and forth between the Salt River Pima Maricopa Indian Community, Fort McDowell Yavapai Nation, and Lower Verde River area of the Cave Creek Ranger District.

After a proposal to round up the horses, there was a large local, national, and international outcry for the horses to remain in their current location. Historically, there has been no management of the horses or herd, now identified as the Salt River horse herd, by any agency, either State or Federal. The 1985 Tonto forest plan does not address the Salt River horse herd as it had not yet been identified or addressed for Forest management.

On May 11, 2016, Arizona Governor Doug Ducey signed House Bill 2340 (Laws 2016, 2nd Regular Session, Chapter 136), which amends Arizona Revised Statute to add an article that protects the Salt River horse herd. This newly added article:

(a) protects the horses from being harassed, shot, injured, killed, or slaughtered;

(b) requires written authorization from the Arizona Department of Agriculture or the Maricopa County Sheriff's Office before interacting with a horse from the herd;

(c) clarifies that horses from the Salt River horse herd are not considered stray livestock under Arizona law; and

(d) directs the Arizona Department of Agriculture to enter into an agreement with the US Forest Service to implement this article or to address any issues relating to the Salt River horse herd. Section 2 of House Bill 2340 requires the Arizona Department of Agriculture and US Forest Service to enter into an intergovernmental agreement pursuant to Arizona Revised Statute §11-952 for the law to become effective.

Affected Environment

The University of Arizona completed a forage assessment of the lower Salt River area, which includes the Salt River Horse Management Area location (Noelle et al. 2018). This forage assessment indicated that the observed environment was unable to sustain the large population of horses that reside in this area. The breakdown of dietary conditions using fecal analysis supports that the horses diet consists of 80 percent mesquite, which is not a typical diet that effectively supports proper nutrition for an equine. The Salt River horses have adapted to utilizing river grass when available as well as giant reed (arundo) that is found along the riverbanks to further supplement their nutrition. Salt River horses have been observed to also utilize natural forage that becomes available based on rainfall.

Observations of forest conditions and Salt River horse health from February through April 2018 were extremely poor. There was no available forage and approximately 100 to 150 horses appeared to have a body condition score of 2 or less from the Henneke Body Condition score chart. Several horses were removed by local advocates and requests from the public were submitted to provide supplemental feeding funded by the public to stop a die off. Supplemental feeding implementation began in April of 2018. The Salt River horse herd improved in body score condition and currently the only supplemental feed they are receiving is diversionary feed from the road during special events and also supplemental feed for remote delivery of birth control.

One of the noticeable examples of resource damage from the Salt River Horses Herd are the negative impacts to mesquite trees. Most mesquite trees that are found along the lower Salt River area, in developed recreation sites, and in areas where higher concentrations of horses are observed are hedged to the height of an average adult horse with its head extended into the air. This likely affects the available habitat for small animals, dove/quail, and small predators that would feed on these critters such as coyote, fox, and badgers. This example of resource damage can, however, have positive impacts to recreation; field staff do not need to spend as much time and resources trimming trees within the developed recreation sites, there may be less user conflicts with snakes, and recreationists may make use of the trails created by horse travel. See each resource section for more information on existing conditions of specific resources.

Environmental Effects

This analysis is concentrated exclusively on the effects of the revised forest plan and the alternatives on the management of the Salt River Horse Herd. This analysis does not cover the impacts for management of the herd on other resources as Arizona Department of Agriculture is the management agency. This analysis also does not discuss the effects of other resources on the herd itself, but instead, on the ability to manage the herd in its current location, within the Salt River Horse Management Area.

This analysis relies heavily on field data and observations collected by volunteers, advocates, and Arizona Game and Fish Department and Forest Service field staff. The location of the management area was chosen based on results of the March 2017 Arial Survey completed by the Arizona Game and Fish Department, Forest Service, and Arizona Department of Agriculture, and where the horses are known to occur. It is assumed that the horses identified to be part of the Salt River Horses Herd will not be entirely contained within this area and will occasionally move between adjacent lands including the Salt River Pima Maricopa Indian Community, Fort McDowell Yavapai Nation, Lower Verde River area of the Cave Creek Ranger District, and Lower Salt River area of the Mesa Ranger District. It is also assumed that any existing fence lines between different land ownerships is not maintained on a daily basis and is likely damaged or missing in multiple locations.

For the purposes of the analysis, the following field observations are assumed to be correct and expected to continue for at least the next five years:

- Ninety-five percent of the mesquite trees in this area hedged to the height of an adult horse’s reach when its neck is fully extended in the air.
- The population of the Salt River horse herd creates a constant disruption in the area which deters other wildlife from residing in the area. The Salt River horse herd has grown accustomed to human presence and do not easily scare. The horses willingly walk through crowded recreation areas and are beginning to expect to find nonnative food in developed recreation sites.
- The presence of horses draws public attention, and it is common for local recreationists and wildlife enthusiasts to gather in areas where the horses are present.
- Horses were not observed to habituate on the riverbanks; however, they were observed to linger within the river for the majority of their days once the temperature reached 87 degrees Fahrenheit. Horses were observed to over utilize any available resource for food when it was seasonally available from March to December 2018. Horses were observed to resort to eating their own manure when there were no available forage resources.
- Based on the Bureau of Land Management statistics for wild horse populations and observed growth rates over the last several years that are consistent with this rate, the Salt River Horse Herd will continue to grow in size at a rate of approximately 20 percent per year.

- It is also assumed that the public will continue to value the presence of horses in the Lower Salt River area, which is now part of the Salt River Horse Management Area.

Effects Common to All Alternatives

The Salt River Horse herd are located in a high-use area on the forest, placing the herd and the recreating public in the same location. Public safety is a concern when the public becomes intrigued by the presence of the herd and does not pay attention to their surroundings. For example, cars may be parked in no parking zones, blocking access to sites, or haphazardly stopped on the road shoulder. The public may also attempt to feed the horses with picnic food items, which may adapt the horses to being fed and obtaining food from humans, even when no food is present. If the horses become accustomed to human food, they may become violent and hazardous to the safety of recreationists.

Sensitive soils and riparian habitats may be damaged if a large number of horses are constantly walking through these areas without allowing recovery time for the resources. These large animals compact the soil, affecting future growth of natural vegetation. Water qualities may also degrade from an excessive amount of manure, as well as soil conditions and scenic values from the buildup on the landscape. In the given space with the size of the herd, the amount of manure may not be able to naturally break down based on normal weather conditions in this environment. Wildlife may also be stressed as the herd consumes all available forage in the area, and cultural resources may be damaged if not protected from trampling by the herd. See each resource section for more information on the effects of the Salt River horse herd.

Effects Common to Alternative A

Alternative A does not include the Salt River horse management area. It also does not provide any plan components or management approaches for the Salt River Horses. Continued use of the existing forest plan, would have no effect on management the Salt River horse herd but would continue to have negative impacts on the natural resources within the Salt River Horse Management Area due to the large number of horses in the herd and the competing uses of the land.

Effects Common to All Action Alternatives (Alternatives B, C, and D)

Alternatives B, C and D have minimal plan components for management within the Salt River Horse Management Area including desired conditions. The desired conditions promote a safe environment for multiple uses of the forest in colocation with the Salt River horses. Additional plan components include not permitting livestock grazing and closing target shooting within the Salt River Horse Management Area (SRHMA-S-02, SRHMA-S-04). They also address user conflicts and help to protect natural resources by preventing the Salt River horses from being in developed recreation sites and other sensitive areas (SRHMA-G-01). Alternative C would have similar effects as the other alternatives, with the main difference being allowable access to manage the herd. Until a management plan for the herd is finalized and implemented by Arizona Department of Agriculture, the extent of how this alternative would affect the herd and management of the herd cannot be determined.

Effects of Management Areas

Implementation of management areas that overlap with the Salt River Horse Management Area are addressed in the sections below. Upon further review requested within public comments on the draft environmental impact statement, the Tonto National Forest has removed the Lower Salt River from eligibility in the National Wild and Scenic Rivers System based on its inability to meet the definition of free-flowing. That area has been removed from the analysis as it no longer overlaps with the Salt River Horse management area.

Lakes and Rivers Management Area

In alternatives B and D, the Lakes and Rivers Management Area emphasizes providing diverse and safe recreation experiences for the public. Within this area, actions may include restricting horse access from populated areas to increase safety for the recreating public. It may also hinder placement of infrastructure related to horse management (e.g., water troughs) in developed recreation areas.

Bush Highway Research Natural Area

This designated research natural area is in all alternatives, with the purpose of “nondisruptive research and education. Use restrictions will be imposed to keep areas in their natural or unmodified condition” (p. 103). As written, management of horses within the research natural area could be limited or restricted.

Goldfield Inventoried Roadless Area

In all alternatives, a small section of this existing management area falls within the area where the Salt River horse herd will be managed. Inventoried roadless areas do not permit the building of new roads, which could affect the management of the herd if the future management plan determines that additional vehicle access is necessary.

Recommended Wilderness

The Four Peaks Wilderness Contiguous Area B (polygon 38) is only proposed in alternative C. It lies on the very eastern part of the Salt River Horse Management Area. The recommended wilderness would be managed to retain or improve wilderness characteristics which would minimally affect forest management. Some of these effects may include restricted vehicular access, restrictions on equipment used to install fences, and limitations on drone use for surveys, etc.

Apache Leap Special Management Area

Affected Environment

The Apache Leap Special Management Area consists of extremely rugged terrain located east of the Town of Superior in the Globe Ranger District. The management area, designated by Congress in December 2014, is named after its prominent feature, a western-facing escarpment of sheer cliff faces, hoodoos, and buttresses known as “Apache Leap.” Other features of the special management area include eastern slopes containing canyons and drainages leading to Oak Flat, relatively undisturbed landscape, open space, and dominant backdrop to the Town of Superior and the adjacent U.S. Route 60 (a designated State Scenic Highway). The Apache Leap Special Management Area includes approximately 839 acres of land currently under federal and private ownership. Upon completion of the Southeast Arizona Land Exchange (Section 3003 of PL 113-291), the Apache Leap Special Management Area will include only Federal lands.

The Apache Leap Special Management Area is extremely rugged. Present uses of the Apache Leap Special Management Area include Native American traditional and ceremonial use, public recreation (hiking, rock climbing, mountain biking), hunting, and energy distribution (power transmission corridor). There are existing routes (both Forest Service roads and remnants of old, mining-related roads) that occur around and within the Apache Leap Special Management Area that are currently used for both motorized and nonmotorized access into the area. This includes Forest Road (FR)315, used to access the east side of the Apache Leap Special Management Area, and FR2440 and FR282, each used to access the west side of the Apache Leap Special Management Area. Resolution Copper has authorized motorized use of FR2440 to access two hydrological monitoring wells (QC-04 and MB-03) currently permitted under the 2010 Pre-feasibility Plan of Operations (USDA Forest Service 2010a).

In December 2017, the Tonto National Forest finalized development of a management plan for the Apache Leap Special Management Area. This plan establishes a comprehensive framework for managing the Apache Leap Special Management Area as specified in the Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015. The National Defense Authorization Act directed the Forest Service to prepare a management plan for the Apache Leap Special Management Area in consultation with affected Indian Tribes, the Town of Superior, Resolution Copper Mining, LLC (Resolution Copper), and interested members of the public. Direction contained in this plan was incorporated by reference into the 1985 Tonto forest plan.

The Apache Leap management plan complies with the three primary purposes outlined in the National Defense Authorization Act:

- Preserve the natural character of Apache Leap
- Allow for traditional uses of the area by Native Americans
- Protect and conserve the cultural and archaeological resources of the area

The National Defense Authorization Act Section 3003 also includes direction for the exchange of the approximately 142-acre Apache Leap South End Parcel, presently owned by Resolution Copper, to the Forest Service. This parcel will be added to an existing area of the Tonto National Forest (about 697 acres) to form the approximately 839-acre Apache Leap Special Management Area. The area covered by this plan lies within the administrative boundaries of the Globe Ranger District of the Tonto National Forest in Pinal County, Arizona. The Apache Leap Special Management Area is located on the eastern edge of the Town of Superior, Arizona.

Environmental Effects

Effects Common to All Alternatives

Under all alternatives the Apache Leap Special Management Area will be managed preserving the area's natural character, allowing traditional uses by Indian Tribes, and protecting and conserving the cultural and archeological resources of the area. The Apache Leap Special Management Area management plan is incorporated by reference and is consistent with forest plan direction. The management direction is designed to guide limited uses compatible with the area's primary purpose, which would protect the unique values for which this area was identified. Under all alternatives the values for which the area was designated will be protected, which would ensure the area is enjoyable for present and future generations.

The presence of this area ensures persistence of natural resources that occur within the area including acorns, medicinal and other edible plants, wild game, and water, all of which are considered life-sustaining for Indian Tribes. Additionally, effects of the conservation of the area would protect and conserve the scenic values, especially as the background for the city of superior, which are values by the publics who utilize the forest.

Alternative A Effects

Apache Leap Special Management Area is represented by management area 2G in alternative A. This management area outlines the management objectives and land use prescriptions but does not incorporate standards and guidelines for the area. While the Tonto National Forest manages to preserve the area's natural character, allow traditional uses by Indian Tribes, and protect and conserving the cultural and archeological resources of the area, the methods for accomplishing this would rely on the Apache Leap Special Management Area Management Plan (December 2017) for all management direction for the area. By not incorporating specific standards and guidelines there are no sideboards for management, which could result in difficulty in accomplishing project work or protecting resources utilizing tools such as area closures.

Effect Common to All Action Alternatives (Alternatives B, C, and D)

The action alternatives incorporate guidelines specific to the enacting legislation for Apache Leap Special Management Area. These guidelines focus on protecting the cultural, archaeological, or historical resources of Apache Leap (ALSMA-G-01). This may affect other resource areas because there may be permanent or seasonal closures of all or a portion of the area. This could limit access for activities such as recreational use or resource management. The action alternatives also incorporate a guideline to continue to provide access to the area for recreational activities, such as rock climbing, so long as the activity and use is consistent with the protection of cultural, historic, or archeological resources in the area (ALSMA-G-02). This would result in beneficial effects to the recreation program, where the recreational activities are recognized as important within this area.

Cumulative Effects: Management Areas

Because Forest management for management areas has been designed to conserve areas with unique characteristics, there have been fewer adverse effects on management areas' natural resources than on the resources of non-designated areas. Future actions on management areas will maintain and enhance the character and resources of each.

Actions that may result in adverse effects on natural resources on the Tonto National Forest, including those in management areas, include urban development on private land, road construction, other ground-disturbing actions proposed by other agencies and local governments, fuels management projects, mining and minerals exploration, and grazing. The degree of cumulative effects, however, would not be exacerbated by additive effects from management of designated and special areas. Non-National Forest System lands actions would not typically affect the use of lands in management areas of the Tonto unless they significantly degrade their natural resources.

Changes in status on Tonto National Forest lands often results in changes in use allowed on those lands under Forest Service manual direction. Recommendation of wilderness, research natural areas, and other management areas are changes in land status and as such restrict certain activities from occurring, such as forest product harvesting or firewood cutting, road building, certain fire suppression or fuel management activities, or energy development. This could impact the economic viability of some surrounding communities and decrease the access to the forest for the general public. These same changes in status, though, often create opportunities for other types of recreational activities, ecological benefits, or both (USDA Forest Service 2015). Regardless of which alternative is selected, effects may occur.

Forest plan revisions on the neighboring forests could potentially impact management of regional unroaded or wild and scenic river resources. Currently, the Kaibab, Apache-Sitgreaves, and Prescott, Coconino and Coronado National Forests have revised forest plans with recommended wilderness areas. The recommended wilderness areas would contribute to a positive cumulative effect because additional wilderness would decrease the existing visitor pressure on the Tonto, which has a high demand for wilderness experiences because of its proximity to urban areas. Recommendations for new wilderness areas, wilderness study areas, and research natural areas would enhance user recreational experiences and opportunities for scientific research on the Tonto. Users who enjoy a wilderness experience and quiet recreation would benefit from the presence of recommended wilderness, while those who prefer motorized recreation would not. None of the alternatives would have a significant additive effect that would contribute to cumulative effects on or off the Tonto.

Management for wilderness character by all alternatives is expected to reduce resource damage resulting from motorized and mechanized uses. On the other hand, because of wilderness restrictions, management of additional areas as wilderness may impede Forest Service accomplishment of fuels and vegetation management projects, which would increase the risk of uncharacteristically severe wildfire. It is possible that this increase would contribute to a cumulative effect when considered additively with other non-forest actions that increase the risk of uncharacteristically severe fire. Should such fires occur, impacts on and off the Tonto may be severe. Loss of property, injury, or mortality and effects on natural resources could occur.

Impacts resulting from fire suppression activity include possible use of motorized equipment such as chainsaws for fire line construction, helicopters, and application of retardant. Minimum impact suppression tactics are used to minimize suppression impacts to the greatest extent possible, while meeting the overall suppression objective. Restoring natural fire regimes is compounded by the risk to natural and cultural resources, property, and visitors, both within designated areas on adjacent lands. Fire, in its natural role, can enhance the natural quality of wilderness character by improving the health and function of that ecosystem. Wildland fire would continue as a reintroduced process in designated areas under all alternatives, unless in conflict with research being conducted in any area.

Overcrowding in wilderness areas close to large metropolitan areas, such as Phoenix, is a common concern of resource managers in the region. As a result, the addition of new wilderness areas on other national forests and lands of other ownership would contribute to a cumulative decrease in visitor pressure on the Tonto, which because of its proximity to urban areas has a high demand for wilderness experiences. Within the planning period, human population growth—as well as growth and demand for a variety of recreation settings and opportunities is expected to increase. A growing human population places increasing demands on recreation that could result in more human concentration and use at existing recreation areas, increased conflicts, increased density in motor vehicle use, and reduced quality of recreation settings. If new development occurs on non-forest lands adjacent to any of the existing wilderness areas, effects could include increased noise, modified landscapes, and motorized trespass.

Wild and scenic river corridors (designated and eligible) with mixed non-federal ownership around the river corridor may have cumulative consequences because interim management and forest plan direction only applies to federal lands. Land use practices on these surrounding lands could pose negative consequences to wild and scenic river areas if water resources are shared, such as increased sedimentation in water from ground disturbing activities (e.g., tree harvesting, grazing, tilling, agriculture, road maintenance or development), or impact outstandingly remarkable values like cultural or historic resources, scenery, geologic formations, recreation access, or fish and wildlife needs near the Tonto National Forest boundary. Ultimately, cumulative effects to the wild and scenic river values on the Forest are likely to be minimal, as the management guidelines for these areas should be sufficient to buffer these areas from most detrimental effects.

Research natural areas and botanical areas are located within the interior of the forests, activities occurring off-forest should have no or extremely limited cumulative effects. Establishment of research natural areas and botanical areas in the forests should contribute to the vegetation communities within the existing research natural area system and provide a potential scientific basis for climate change research. Cumulatively, the regional network of research natural areas and other special areas would provide opportunities for non-manipulative research and education opportunities across a diversity of landscapes, high quality examples of unique ecosystems and ecological features, and rare or sensitive special of plants and animals and their habitat.

National Trails, like the Arizona National Scenic Trail, are not entirely on the Tonto National Forest, and since most private lands and other ownerships do not have the same regulations for natural resource management, the effects of ongoing developments or activities next to or within National Forest System land boundaries can sometimes be quite noticeable when viewing the continuous landscape potentially affecting the visitor's satisfaction and quality of the their experience on a long-distance designated trail.

Comprehensive management plans for nationally designated scenic and historic trails are developed guide management along the entire length of a trail to protect and enhance the nature and purpose for which the trail was designated including historic, scenic and recreational qualities across ownership boundaries, reducing any negative cumulative consequences. The cumulative environmental consequences of proposed management efforts in the context of the larger cumulative effects analysis area though comprehensive management plans would contribute to the movement of designated trail values toward desired conditions. Ultimately, movement toward desired conditions for designated trails would provide tourism benefits for the region and communities which they traverse and contributes to sustainable social and economic systems.

Significant caves are located throughout the forest and would have the same cumulative effects as other caves and karsts on the forest. Continuous access and use of caves could result in degradation of cave resources. Touching the walls of caves could leave residual matter that over time could have a visual effect. Lint, hair, skin cells, and other residual matter could result in an adverse biological change to the cave. In addition, multiple disturbances within the drainage area of a cave entrance could result in sedimentation of the cave. These disturbances could include wildfire, prescribed fire, and mechanical treatment of vegetation. There are no known cumulative effects from the proposed watershed management, soil management, cultural resource management, transportation management, special area management, or management of paleontological resources to cave resources in any of the alternatives.

The water and infrastructure within the lakes and rivers management area is controlled by Salt River Project. Management decisions by this group have the potential to impact the water levels within the lakes and river, which then could impact recreation values, especially for water-based types of recreation. This area is primarily managed for recreational purposes and the cumulative effects of the presence of this area would be similar to the cumulative effects of recreation on the forest.

Any proposals on lands directly adjacent to the Salt River Horse management area, such as the Salt River Pima Maricopa Indian Community and Fort McDowell Yavapai Nation, related to moving, adding to, or removing the Salt River horse herd could potentially impact the Salt River Horse Management Area. The number of horses on the Tonto National Forest could increase or decrease, directly affecting other Forest resources (e.g., increased herd size would increase impacts to soils and grazing and decreased herd size would allow vegetation to grow back and soils to restabilize). Additional horses in the herd may impact resources more severely, and a reduction in the herd size may improve certain resource conditions. Until a management plan for the Salt River Horses has been finalized and implemented by the Arizona Department of Agriculture, it is unknown exactly how these kinds of proposals would affect management of the Salt River Horse Management Area.

Short-term Uses and Long-term Productivity

The National Environmental Policy Act 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).

The revised forest plan would govern management of the Tonto National Forest's resources for the next 10 to 15 years. The environmental impact statement discloses the effects for a range of alternatives, including taking no action. It considers effects on the significant issues and other resources for this timeframe. Overall, under all alternatives, design and implementation of projects and activities consistent with the direction in this forest plan would ensure the short-term uses, long-term productivity, ecological integrity, and ecological diversity of National Forest System lands within the Tonto National Forest.

Unavoidable Adverse Effects

The forest plan provides a programmatic framework that guides site specific actions but does not authorize, fund, or carryout any project or activity. Before any ground-disturbing actions take place, they must be authorized in a subsequent site-specific environmental analysis. Therefore, none of the alternatives cause unavoidable adverse impacts.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, 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 such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

The forest plan provides a programmatic framework that guides site specific actions but does not authorize, fund, or carryout any project or activity. Because the forest plan does not authorize or mandate any site-specific project or activity (including ground disturbing actions), none of the alternatives cause an irreversible or irretrievable commitment of resources.

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Chapter 4. Preparers and Contributors

Interdisciplinary Team Members

The list of preparers in table 207 is limited to those people who were members of the interdisciplinary team working on the final documents or who made significant contributions during the preparation of the environmental impact statement[45]. Preparation of these documents could not have been completed without the support and assistance of numerous employees on the Tonto National Forest, past employees who have retired or moved to other positions, and colleagues in the regional office. We also recognize the regional and forest leadership teams as providing guidance during this process.

Table 207. Interdisciplinary Team Members

Name and Title	Involvement with the Environmental Impact Statement	Qualifications
Richard Adkins; *Tribal Relations Program Manager*	Tribal resources and Apache Leap special management area analysis.	Ph.D. from the University of Oklahoma. Thirty-three years' experience working with cultural resources and with Tribal governments.
Kelly Araiza; *Dispersed Recreation Program Manager*	Core team member. All sections of recreation analysis and support on the lakes and rivers management area and special uses analysis. Support on environmental impact statement development.	B.S. Environmental Science Northern Arizona University; Eleven years with Forest Service.
Lee Ann R. Atkinson; *Minerals National Environmental Policy Act Coordinator/Minerals Administrator*	Mining, minerals, and abandoned mines analysis.	M.S. Geology-Geophysics, University of Wisconsin Milwaukee. Seventeen years with Forest Service.
Kenna Belsky; *Forest Planner*	Core team member. Scenery analysis. Support on environmental impact statement development.	M.A.S. Geographic Information Systems, B.S. Urban and Environmental Planning, Arizona State University. Eleven years with Forest Service.
Travis Bone; *Forest Archeologist*	Cultural and historic resources and Apache Leap special management area analysis.	M.A. Anthropology, Northern Arizona University, focus in Southwest material culture. Professional archaeologist with twenty-one years of federal service.
Allison Borchers; *Forest Service Enterprise Unit Economist*	Economic analysis	Ph.D. Economics, University of Delaware. Nine years with Forest Service, Economic Research Service
Ralph Brown; *Realty Specialist*	Support for special uses analysis.	M.S. Public Administration, Troy University Alabama. Nine years with Forest Service.
Paul Burghard; *Trails Program Manager (retired)*	Support for designated area analysis	Tonto Recreation Program and Trails Coordinator; Eighteen years with the Forest Service.
Marina Copeland; *(former) GIS Specialist*	Environmental impact statement maps	Current Master's student at Arizona State University.

[45] Unless otherwise noted, the people in the table are Tonto National Forest employees.

Name and Title	Involvement with the Environmental Impact Statement	Qualifications
Justin Eddinger; *(former) GIS Specialist and Acting Trails Program Manager*	Environmental impact statement maps. Support for designated area analysis.	M.A.S. Geographic Information Systems, Arizona State University. Four years with Forest Service.
Dave Franquero; *Civil Engineering Technician*	Roads analysis.	College course work towards B.S. at Northern Arizona University. Twenty-nine years with Forest Service.
Makenzie Gleave; *Salt River Horse Liaison, Arizona Department of Agriculture*	Salt River Horse management area analysis.	
Benjamin (Chad) Harrold; *Geologist/Cave and Karst Program Manager*	Cave and karst and significant caves analysis.	M.S. Geology, Auburn University. Three years with Forest Service.
Kristina Hill; *(former) Forest Archaeologist/Heritage Program Manager*	Cultural and historic resources analysis.	M.A. Anthropology, University of Missouri Columbia. Fifteen years with Forest Service.
Brandon Hollingshead; *(former) Outreach Intern*	Core team member (10 months).	Current student at Arizona State University.
Jacquelyn Hughes; *(former) Salt River Horse Liaison, Arizona Department of Agriculture*	Salt River Horse management area analysis.	25+ years of education and practical application of managing equines; about 3 years with Arizona Department of Agriculture
Peter Hyde; *Air Quality Consultant, Applied EnviroSolutions, Inc.*	Air quality analysis.	B.S. Chemistry, University of Illinois, thirty-three years with Pima County and AZ Dept. of Enviro. Quality. Twelve years with AZ State University and Applied EnviroSolutions as air quality consultant.
Bianca Garcia; (former) *Planning Intern*	Core team member (6 months).	B.S. Earth and Environmental Studies, minor in Sustainability, Arizona State University
Martin Godusi; *Vice President, Applied EnviroSolutions, Inc.*	Air quality analysis.	M.S. Chemical Engineering, University of Arizona. Seven years with Pinal County and AZ Dept. of Enviro. Quality. Twenty-five years air quality consulting with Applied EnviroSolutions.
Mary Lata; *Fire Ecologist*	Fire and fuels and ecological response units analysis.	Ph.D. Geoscience, University of Iowa. Twenty years with Forest Service.
Jeff Leonard; *Contracting Officer (Retired)*	Vegetation, forestry and forest products analysis, and timber suitability.	B.S. Forest Science, Northern Arizona University. Twenty-eight years with Forest Service.
Grant Loomis; *Forest Hydrologist (Retired)*	Hydrology analysis.	B.A. Economics, University of California Davis. Thirty years with Forest Service.
Nanebah (Noni) Lyndon; (*former) Tribal Relations Program Manager*	Tribal resources analysis.	M.A. Cultural Anthropology, Arizona State University. Ten years with Forest Service.

Name and Title	Involvement with the Environmental Impact Statement	Qualifications
Robert Madera; *Forest Botanist*	Core team member and ecological team lead. Riparian areas, seeps, springs, and wetlands analysis. Support for vegetation analysis, timber suitability, and management area analysis. Evaluation of designated and proposed areas appendix.	M.S. Plant Biology and Conservation, Arizona State University. Five years with Forest Service.
Alexander Makic; Hydrologist	Watersheds and water resources analysis.	B.A. Environmental Physics, Colorado College. Hydrologist with the Forest Service for two years.
Alex Mankin; *(former) Geologist*	Support for mining and minerals analysis.	M.S. Geology, University of Texas at Arlington. Three years with Forest Service.
Georgia McAlister; *(former) Planning Intern*	Core team member (5 months)	B.S. Community and Regional Planning, Iowa State University
Mark McEntarffer; *Realty Specialist*	Lands and access, special uses, and energy analysis.	B.S. Public Planning Geography, Northern Arizona University. Eleven years with Forest Service.
Alison Mettler; *Realty Specialist*	Lands and access and special uses analysis.	M.S. Public Administration and Public Policy, B.S. Public Administration, Parks and Recreation, and a Certificate in Public Policy from Arizona State University. Four years with the Forest Service.
Kelly Mott Lacroix; *Forest Hydrologist*	Watersheds and water resources analysis.	Ph.D. Arid Lands Resource Sciences, University of Arizona. Five years with Forest Service.
Chandler Mundy; *Range Program Manager*	Rangelands, Forage, and Grazing, Saguaro Wild Burro Management Area, and Salt River Horses Management Area analysis.	B.S. Rangeland Resources, Utah State University. Seventeen years with Forest Service.
LeAnne Murphy, PE; *Facilities Engineer*	Facilities analysis.	B.S. Civil Engineer, University of Alaska Fairbanks. Professional Engineer. Thirty-three years with the Forest Service.
Ryan Nicholas; *Ecologist*	Soils and Invasive species analysis.	Ph.D. Urban Forestry, Southern University A&M. B.S. in Plant and Soil Science, Southern University A&M. Fifteen years with Forest Service.
Jay Olson; *Fish and Wildlife Biologist*	Core team member. Wildlife, fish, and plants, at-risk species, and habitat connectivity analysis. Species of conservation concern lead.	M.S. Wildlife and Wildland Conservation, Brigham Young University. Five years with Forest Service.
Matt Quinn; *Trails and Wilderness Coordinator*	Designated wilderness and national trails analysis and support for dispersed recreation.	Masters of Environmental Management, Western Colorado University. Four years with the Forest Service.
Devin Quintana; *Public Services Staff Officer*	Support for recreation analysis.	

Name and Title	Involvement with the Environmental Impact Statement	Qualifications
Judd Sampson; *(former) Forest Geologist*	Mining and minerals analysis.	B.S. Earth and Space Exploration, Arizona State University 2011. Four years with Forest Service and three years with Bureau of Land Management.
Gregory Schuster; *Recreation Planner*	Support for recreation and scenery analysis.	M.N.R.M. Parks, Recreation and Tourism Management, North Carolina State University. Eight years with Forest Service.
Jason Scow; *Zone Recreation Staff (Cave Creek, Globe, Mesa)*	Support for recreational shooting and lakes and river management area analysis.	B.S. Recreation Resource Management, Utah State University. Twenty years with Forest Service.
Don Sullivan; *Wilderness River Manager*	Support for wilderness and wild and scenic river analysis.	B.S. Sociology from Northern Arizona University. Twenty-three years with Forest Service.
Anne Thomas; *Forest National Environmental Policy Act Coordinator*	Environmental Justice analysis. Support on environmental impact statement development.	M.S. Human Dimensions of Ecosystem Science and Management, Utah State University. Eleven years with Forest Service.
Elizabeth Wadsworth; *(former)* Assistant Forest Planner	Core team member. Recommended wilderness appendix. Wild and scenic river appendix. Support on environmental impact statement development.	M.S. Urban and Regional Planning, University of Iowa. Five years with Forest Service.
Brooke Wheelock; *Partnerships and Volunteers Coordinator*	Partnerships and volunteers analysis.	M.Ed. Parks and Recreation Management, Southwester Oklahoma State University. Ten years of federal service.
Frank Williams; *GIS Specialist*	Forest plan and environmental impact statement maps and analysis.	B.S. Forestry and Outdoor Recreation Management, Southern Illinois University, Carbondale. Eleven years of federal service.
Kelly Wolff; *Habitat Evaluation and Lands Program Manager, Arizona Game and Fish Department*	Fish and wildlife related recreation analysis. Support for wildlife, fish, and plants and recreation.	B.S. Environmental Resources, Emphasis in Wildlife Habitat. Arizona State University. Seventeen years with Arizona Game and Fish Department.
Tyna Yost; *South Zone National Environmental Policy Act Coordinator*	Recreational shooting analysis. Support for forest plan and development of environmental impact statement.	M.S. Plant Biology and Conservation, Arizona State University. Eight years with Forest Service.

Distribution of the Environmental Impact Statement

A notice of the availability of the environmental impacts statement was published in the Federal Register. In addition, a legal notice was published in the newspaper of record, The *Arizona Capital Times*. The EIS and relevant announcements were also posted to the Forest website.

This environmental impact statement has been distributed to or made electronically available to federal agencies (as required by 40 CFR 1502.19), federally recognized Tribes, state and local governments and agencies, and organizations that have requested to be involved in the development of this analysis. These entities include but are not limited to the US Environmental Protection Agency; US Army Corps of Engineers; US Department of Energy, US Department of the Interior; Federal Highway Administration; National Oceanic and Atmospheric Administration; Federal Energy Regulatory Commission; Advisory Council on Historic Preservation; USDA National Agricultural Library; USDA Animal and Plant Health Inspection Service; USDA Natural Resource Conservation Service; Office of Environmental Policy and Compliance; Arizona Game and Fish Department; Arizona Department of Agriculture; county commissions; and local community governments. In addition, copies have been distributed to, or made electronically available to over 4,000 individuals and groups who specifically requested a copy of the document, indicated they wished to receive updates on the project, or commented during public involvement opportunities.

Glossary

Adaptation. Adjustment in natural or human systems to a new or changing environment. Adaptation includes, but is not limited to, maintaining primary productivity and basic ecological functions, such as energy flow; nutrient cycling and retention; soil development and retention; predation and herbivory; and natural disturbances. Adaptation occurs primarily by organisms altering their interactions with the physical environment and other organisms.

Adaptive capacity. The ability of ecosystems to respond, cope, or adapt to disturbances and stressors, including environmental change, to maintain options for future generations. As applied to ecological systems, adaptive capacity is determined by:

4. Genetic diversity within species in ecosystems, allowing for selection of individuals with traits adapted to changing environmental conditions.
5. Biodiversity within the ecosystem, both in terms of species richness and relative abundance, which contributes to functional redundancies.
6. The heterogeneity and integrity of ecosystems occurring as mosaics within broader-scaled landscapes or biomes, making it more likely that some areas will escape disturbance and serve as source areas for re-colonization.

Adaptive management. Adaptive management is the general framework encompassing the three phases of planning: assessment, plan development, and monitoring (36 CFR 219.5). This framework supports decision-making that meets management objectives while simultaneously accruing information to improve future management by adjusting the plan or plan implementation. Adaptive management is a structured, cyclical process for planning and decision-making in the face of uncertainty and changing conditions with feedback from monitoring, which includes using the planning process to actively test assumptions, track relevant conditions over time, and measure management effectiveness.

Airshed. A geographic area that, because of topography, meteorology, and/or climate is frequently affected by the same air mass.

Assessment. For the purposes of the land management planning regulation at 36 CFR part 219 and this Handbook, an assessment is the identification and evaluation of existing information to support land management planning. Assessments are not decision-making documents but provide current information on select topics relevant to the plan area, in the context of the broader landscape (36 CFR 219.19).

At-risk species. A term used in land management planning and this Handbook to refer to, collectively, the federally recognized threatened, endangered, proposed, and candidate species and species of conservation concern within a plan area.

Authorized livestock numbers. Year to year actual stocking of livestock on a grazing allotment, based on forage and water availability, condition of range improvements, climatic conditions, personal convenience for the permittee, or resource protection. Authorized numbers are not necessarily the number on the permit.

Basal area. The cross-sectional area at breast height (4.5 feet above the ground) of trees measured in square feet. Basal area is a way to measure how much of a site is occupied by trees. The cross-sectional area is determined by calculating the tree's radius from its diameter (diameter/2 = radius) and using the formula for the area of a circle ($A = \pi r^2$). Basal area per acre is the summation of the cross-sectional area of all trees in an acre or in a smaller plot used to estimate basal area per acre. Diameter at root collar (defined below) is used to calculate the cross-sectional area of multi-stemmed trees such as juniper and oak.

Base area. The main area at the bottom of a winter/summer resort.

Best management practices. Methods, measures, or practices selected by an agency to meet its nonpoint source control needs. Best management practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Best management practices can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters (36 CFR 219.19).

Biological soil crusts. Crusts of soil particles formed by living organisms (such as algae, mosses, lichens) in arid areas. They hold soil in place, help retain moisture, and improve soil nutrients by fixing atmospheric nitrogen.

Broader landscape. For land management planning pursuant to 36 CFR 219, the plan area and the lands surrounding the plan area. The spatial scale of the broader landscape varies depending upon the social, economic, and ecological issues under consideration.

Candidate species (36 CFR 219.19).

- For species under the purview of the US Fish and Wildlife Service (USFWS), a species for which the USFWS possesses sufficient information on vulnerability and threats to support a proposal to list as endangered or threatened, but for which no proposed rule has yet been published by the USFWS.
- For species under the purview of the National Marine Fisheries Service (NMFS), a species that is:
    - The subject of a petition to list as a threatened or endangered species and for which the National Marine Fisheries Service has determined that listing may be warranted, pursuant to section 4(b)(3)(A) of the Endangered Species Act (16 U.S.C. 1533(b)(3)(A)), or
    - Not the subject of a petition but for which the National Marine Fisheries Service has announced in the Federal Register the initiation of a status review.

Chaining. Uprooting of trees and shrubs to create a seedbed by pulling a chain behind two tractors traveling parallel to each other.

Climate change. A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

Climate variability. Refers to shorter term (daily, seasonal, annual, inter-annual, several years) variations in climate, including the fluctuations associated with El Niño (wet) or La Niña (dry) events.

Climax condition (seral stages). The stage where an ecosystem has reached a steady state. Through the process of ecological succession, an equilibrium is reached in which the biological community is best adapted to the average conditions in that area.

Coarse woody debris. Fallen dead trees and the remains of large branches on the ground in forests and in rivers or wetlands.

Collaboration or collaborative process. A structured manner in which a collection of people with diverse interests share knowledge, ideas, and resources, while working together in an inclusive and cooperative manner toward a common purpose. Collaboration, in the context of the land management planning regulation at 36 CFR part 219 and this Handbook, falls within the full spectrum of public engagement described in the Council on Environmental Quality's publication of October 2007: Collaboration in NEPA— A Handbook for NEPA Practitioners (36 CFR 219.19).

Community Wildfire Protection Plan. A comprehensive community-based planning and prioritization approach for protection of life, property, and critical infrastructure in the wildland-urban interface. Protection plans may take a variety of forms based on the needs of the community, but must be collaboratively developed, identify and prioritize areas for hazardous fuel reduction treatments, recommend treatment types and methods, and recommend measures that homeowners and communities can take to reduce the ignitability of structures. The planning process may also identify management options and implications in the surrounding landscape. The Healthy Forests Restoration Act (HFRA) of 2003 instructed the US Forest Service to give consideration of community priorities as outlined in a community wildfire protection plan during planning and implementation of hazardous fuel reduction projects.

Connectivity. Ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long distance range shifts of species, such as in response to climate change (36 CFR 219.19).

Conservation. The protection, preservation, management, or restoration of natural environments, ecological communities, and species (36 CFR 219.19).

Conserve. For the purpose of meeting the requirements of 36 CFR 219.9, to protect, preserve, manage, or restore natural environments and ecological communities to potentially avoid federally listing of proposed and candidate species (36 CFR 219.19).

Critical habitat. For a threatened or endangered species, (1) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of the Endangered Species Act (ESA) (16 U.S.C. 1533), on which are found those physical or biological features (a) essential to the conservation of the species, and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the ESA (16 U.S.C. 1533), upon a determination by the Secretary that such areas are essential for the conservation of the species. ESA, sec. 3 (5)(A), (16 U.S.C. 1532 (3)(5)(A)). Critical habitat is designated through rulemaking by the Secretary of the Interior or Commerce. ESA, sec. 4 (a)(3) and (b)(2) (16 U.S.C. 1533 (a)(3) and (b)(2)).

Cultural resources. An object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Cultural resources are prehistoric, historic, archaeological, or architectural sites, structures, places, or objects and traditional cultural properties. In this chapter, cultural resources include the entire spectrum of resources for which the Heritage Program is responsible from artifacts to cultural landscapes without regard to eligibility for listing on the National Register of Historic Places (FSM 2300, chapter 2360, section 2360.5).

Cumulative effects or impacts. The impact on the environment that results 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 actions. Cumulative impacts can result from individually minor, but collectively significant actions, taken place over a period of time.

Decision document. A record of decision, decision notice, or decision memo (36 CFR 220.3).

Decommission. Treated in such a manner so as to no longer function as intended. Usually in reference to decommissioning of a road so that it no longer is apparent on the landscape.

Defensible space. An area either natural or manmade where material capable of allowing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and property or resources. In practice, “defensible space” is defined as an area a minimum of 30 feet around a structure that is cleared of flammable brush or vegetation.

Departure. The degree to which the current condition of a key ecosystem characteristic is unlike the reference condition.

Designated area. An area or feature identified and managed to maintain its unique special character or purpose. Some categories of designated areas may be designated only by statute and some categories may be established administratively in the land management planning process or by other administrative processes of the Federal executive branch. Examples of statutorily designated areas are national heritage areas, national recreational areas, national scenic trails, wild and scenic rivers, wilderness areas, and wilderness study areas. Examples of administratively designated areas are research natural areas, botanical areas, and significant caves (36 CFR 219.19).

Designated road, trail, or area. A National Forest System road, a National Forest System trail, or an area on National Forest System lands that is designated for motor vehicle use pursuant to 36 CFR 212.51 on a motor vehicle use map (36 CFR 212.1).

Desirable nonnative. Nonnative species that were intentionally released into the wild to establish self-sustaining populations of wildlife that meet public demands for recreation or other purposes (e.g., sport fishes). These desirable nonnative species are not likely to cause ecosystem disruption.

Desired conditions. For the purposes of the land management planning regulation at 36 CFR 219, a description of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined, but do not include completion dates (36 CFR 219.7(e)(1)(i)). Desired conditions are achievable, and may reflect social, economic, or ecological attributes, including ecosystem processes and functions.

Diameter. The diameter of a tree species, usually measured by two primary methods:

- Diameter at breast height (d.b.h.): The diameter of a tree at the bole (or trunk) typically measured at 4.5 feet above ground level.
- Diameter at root collar (d.r.c.): The diameter of a woodland tree species typically measured at the root collar (the part of the tree where the main roots join the trunk, usually at or near ground level) or at the natural ground line, whichever is higher.

Dispersed motorized camping. Camping with motorized vehicles outside of developed campsites.

Dispersed recreation. Outdoor recreation in which visitors are spread over relatively large areas outside developed recreation sites. Where facilities or developments are provided, they are more for access and protection of the environment than for the comfort or convenience of the visitors.

Disturbance. Any relatively discrete event in time that disrupts ecosystem, watershed, community, or species population structure and/or function and changes resources, substrate availability, or the physical environment (36 CFR 219.19).

Disturbance regime. A description of the characteristic types of disturbance on a given landscape; the frequency, severity, and size distribution of these characteristic disturbance types; and their interactions (36 CFR 219.19).

Diversity. An expression of community structure; high if there are many equally abundant species; low if there are only a few equally abundant species. The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Easement. A type of special use authorization (usually granted for linear rights-of-way) that is utilized in those situations where a conveyance of a limited and transferable interest in National Forest System land is necessary or desirable to serve or facilitate authorized long-term uses, and that may be compensable according to its terms (36 CFR 251.51).

Ecological conditions. The biological and physical environment that can affect the diversity of plant and animal communities, the persistence of native species, and the productive capacity of ecological systems. Ecological conditions include habitat and other influences on species and the environment. Examples of ecological conditions include the abundance and distribution of aquatic and terrestrial habitats, connectivity, roads and other structural developments, human uses, and invasive species (36 CFR 219.19).

Ecological integrity. The quality or condition of an ecosystem when its dominant ecological characteristics (e.g., composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (36 CFR 219.19).

Ecological process. The physical, chemical, and biological actions or events that link organisms and their environment including decomposition, production (of plant matter), nutrient cycling, and fluxes of nutrients and energy.

Ecological response unit. A classification of a unit of land that groups sites by similar plant species composition, succession patterns, and disturbance regimes, such that similar units will respond in a similar way to disturbance, biological processes, or manipulation. Each ecological response unit characterizes sites with similar composition, structure, function, and connectivity, and defines their spatial distribution on the landscape.

Ecological sustainability. See sustainability.

Ecological system. See ecosystem.

Economic sustainability. See sustainability.

Ecosystem. (36 CFR 219.19) A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its:

- Composition. The biological elements within the different levels of biological organization, from genes and species to communities and ecosystems.
- Structure. The organization and physical arrangement of biological elements, such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern, and connectivity.
- Function. Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances, such as wind, fire, and floods.
- Connectivity. See connectivity above.

Ecosystem diversity. The variety and relative extent of ecosystems (36 CFR 219.19).

Ecosystem integrity. See ecological integrity.

Ecosystem services. Benefits people obtain from ecosystems, including:

- Provisioning services, such as clean air and fresh water, energy, food, fuel, forage, wood products or fiber, and minerals;
- Regulating services, such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood and drought control; and disease regulation;
- Supporting services, such as pollination, seed dispersal, soil formation, and nutrient cycling; and
- Cultural services, such as educational, aesthetic, spiritual, and cultural heritage values, recreational experiences, and tourism opportunities.

Ecotone. The transition zone between two adjoining ecological communities.

Effect. Environmental change resulting from a proposed action. Direct effects are caused by the action and occur at the same time and place, while indirect effects are caused by the action, but are later in time or further removed in distance, although still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems. Effect and impact are synonymous as used in this document.

Encroachment. An increase in the density and cover of trees or shrubs in grasslands that reduces grass biomass, density, and cover.

Endangered species (federally listed species). Any species that the Secretary of the Interior or the Secretary of Commerce has determined is in danger of extinction throughout all or a significant portion of its range. Endangered species are listed at 50 CFR sections 17.11, 17.12, and 224.101.

Endemic. (1) Describes a population that has unique genetic characteristics and likely exists in a very limited geographic area. (2) Describes a population of native insects, diseases, plants, or animals which perform a functional role in the ecosystem when they are present at low levels, or constantly attack just a few hosts throughout an area but can become potentially injurious when they increase or spread to reach outbreak (epidemic) levels.

Environmental impacts. Possible adverse effects caused by a development, industrial, or infrastructural project or by the release of a substance in the environment.

Ephemeral stream. A stream that flows only in direct response to precipitation in the immediate locality (watershed or catchment basin), and whose channel is at all other times above the zone of saturation.

Even-aged stand. A stand of trees composed of a single age class (36 CFR 219.19).

Federally listed species. Threatened or endangered species listed under the Endangered Species Act, as amended. Candidate and proposed species are species which are being considered for Federal listing.

Federally recognized Tribe. An Indian or Alaska Native Tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian Tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a (36 CFR 219.19).

Fire intensity. The product of the available heat of combustion per unit of ground and the rate of spread of the fire, interpreted as the heat released per unit of time for each unit length of fire edge. The primary unit is British thermal unit per second per foot (Btu/sec/ft.) of fire front. See also fire severity.

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

- Fire regime I – 0-to-35-year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 percent of dominant overstory vegetation replaced).
- Fire regime II – 0-to-35-year frequency and high severity (greater than 75 percent of dominant overstory vegetation replaced).
- Fire regime III – 35 to 100+ year frequency and mixed severity.
- Fire regime IV – 35 to 100+ year frequency and high severity.
- Fire regime V – 200+ year frequency and high severity.

Fire risk. The chance of fire starting, as determined by the presence and activity of causative agents.

Fire severity. Degree to which a site has been altered or disrupted by fire; also used to describe the product of fire intensity and residence time; usually defined by the degree of soil heating or mortality of vegetation.

Fire suppression. The work of extinguishing a fire or confining fire spread.

Focal Species. a small subset of species whose status permits inference to the integrity of the larger ecological system to which it belongs and provides meaningful information regarding the effectiveness of the plan in maintaining or restoring the ecological conditions to maintain the diversity of plant and animal communities in the plan area. Focal species would be commonly selected on the basis of their functional role in ecosystems (36 CFR 219.19).

Forage. Is (1) browse and herbage which is available and can provide food for animals or be harvested for feeding; or (2) to search for or consume forage.

Forested land. Land that is at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use. Lands developed for non-forest use include areas for crops, improved pasture, residential, or administrative areas, improved roads of any width, and adjoining road clearing and power line clearing of any width.

Free-flowing. Existing or flowing in natural conditions without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.

Frequent fire-dependent ecosystem. A vegetation community that requires a fire regime 1 (>35-year fire frequency) in order to maintain its natural function, structure, and species composition.

Functional ecosystem. A system with intact abiotic and biotic processes. Function focuses on the underlying processes that may be degraded, regardless of the structural condition of the ecosystem. Functionally restored ecosystems may have a different structure and composition than the historical reference condition. As contrasted with ecological restoration that tends to seek historical reference condition, function refers to the dynamic processes that drive structural and compositional patterns. Functional restoration is the manipulation of interactions among process, structure, and composition in a degraded ecosystem to improve its operations. Functional restoration aims to restore functions and improve structures with a long-term goal of restoring interactions between function and structure. It may be, however, that a functionally restored system will look quite different than the reference condition in terms of structure and composition and these disparities cannot be easily corrected because some threshold of degradation has been crossed or the environmental drivers, such as climate, which influenced structural and (especially) compositional development have changed.

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

Goshawk foraging areas. The areas that surround the post-fledging family areas (see definition below) that northern goshawks use to hunt for prey. They are approximately 5,400 acres in size.

Goshawk nest areas. The areas immediately around a nest that are used by northern goshawks in relation to courtship and breeding activities. They are approximately 30 acres in size and contain multiple groups of large, old trees with interlocking crowns.

Goshawk post-fledging family areas. The areas that surround northern goshawk nest areas. They represent an area of concentrated use by the northern goshawk family until the time the young are no longer dependent on adults for food. Post-fledging family areas are approximately 420 acres in size (not including the nest area acres).

Groundcover. The layer of dead and living vegetation that provides protection of the topsoil from erosion and drought.

Groundwater-dependent ecosystem. Community of plants, animals, and other organisms whose extent and life processes depend on groundwater (USFS 2022). Examples include many wetlands, groundwater-fed lakes and streams, cave and karst systems, aquifer systems, springs, and seeps.

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

Group selection. An uneven-aged management method in which trees are removed and new age classes are established in groups, adjacent to other groups of different age classes. Group cut size is determined by the reproduction requirements of the species desired and by the number or total acreage of different age classes desired across the stand.

Habitat. The physical location or type of environment in which an organism or biological population lives or occurs.

Habitat fragmentation. The process by which habitat loss results in the division of large, continuous habitats in smaller more isolated remnants.

Habitat type. A land or aquatic unit, consisting of an aggregation of habitats having equivalent structure, function, and responses to disturbance.

Herbaceous. Grass, grass-like, and forb vegetation.

Herbivory. Loss of vegetation due to consumption by another organism.

Hydrologic function. The behavioral characteristics of a watershed described in terms of ability to sustain favorable conditions of waterflow. Favorable conditions of waterflow are defined in terms of water quality, quantity, and timing.

Hydrologic unit code (HUC). A unique hierarchical hydrologic unit based on the area of land that drains to a single stream mouth or outlet at each level, and nested levels are identified by successively longer codes. A HUC 8 sub-basin is 700 square miles or larger and is divided into multiple HUC 10 watersheds that range from 62 to 390 square miles. HUC 12 sub-watersheds are 15 to 62 square miles and nest inside HUC 10 watersheds.

Impaired waters. Polluted or degraded waterbodies (e.g., lakes, streams, segments of streams) which do not meet state water quality standards.

Infill. An increase in trees per acre in forests and woodlands, resulting in a decrease in the quality and size of interspaces.

Infrastructure. Infrastructure the forest manages includes all vertical and horizontal constructed structures. Infrastructure is broken into three categories:

1. Transportation infrastructure includes both the road and trail systems. The road system infrastructure is all forest roads, drainage ditches, culverts, signage, and bridges. The trail system includes all motorized and nonmotorized trails, signage, and bridges.
2. Facilities infrastructure includes administrative and recreation building and sites (e.g., driveways, parking, landscaping); support utilities (e.g., electrical, water, wastewater); dams, and other support buildings.
3. Other infrastructure directly supports natural resources, which includes fish barriers, wildlife drinkers, and range infrastructure (e.g., fencing, trick tanks, water gaps, cattleguards).

Inherent capability of the forest. The ecological capacity or ecological potential of an area characterized by the interrelationship of its physical elements, its climatic regime, and natural disturbances (36 CFR 219.19).

Integrated resource management. Multiple use management that recognizes the interdependence of ecological resources and is based on the need for integrated consideration of ecological, social, and economic factors (36 CFR 219.19).

Intermittent stream. A stream or reach of stream channel that flows, in its natural condition, only during certain times of the year or in several years, and is characterized by interspersed, permanent surface water areas containing aquatic flora and fauna adapted to the relatively harsh environmental conditions found in these types of environments. Intermittent streams are identified as dashed blue lines on USGS 7 1/2-inch quadrangle maps.

Interspaces. Open space between tree groups intended to be managed for grass-forb-shrub vegetation over the long term.

Invasive species. An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. A species that causes, or is likely to cause, harm and that is exotic to the ecosystem it has infested. Invasive species infest both aquatic and terrestrial areas and can be identified within any of the following four taxonomic categories: Plants, Vertebrates, Invertebrates, and Pathogens (Executive Order 13112). Sometimes referred to as nonnative invasive or exotic species.

Jackstrawing. Groups of fallen trees usually resulting from blowdown, avalanche, flood, or insect or disease mortality.

Land grant-merced. A grant of land made by the Government of Spain or of Mexico to a community, town, colony, pueblo, or person for the purpose of founding or establishing a community, town, colony, or pueblo.

Land grant-merced governing body. A community land grant-merced recognized under a State of New Mexico law, statute, or code, with a duly elected or appointed governance body charged with management, care and protection of land grant-merced common lands.

Landscape. A defined area irrespective of ownership or other artificial boundaries, such as a spatial mosaic of terrestrial and aquatic ecosystems, landforms, and plant communities, repeated in similar form throughout such a defined area (36 CFR 219.19).

Leave No Trace. Guidelines that help protect the land and lessen the sights and sounds of forest visitors. http://www.lnt.org/

Line officer. A Forest Service official who serves in a direct line of command from the Chief (36 CFR 219.62).

Litter. Litter consists of dead, unattached organic material on the soil surface that is effective in protecting the soil surface from raindrop splash, sheet, and rill erosion and is at least ½ inch thick. Litter is composed of leaves, needles, cones, and woody vegetative debris including twigs, branches, and trunks.

Livestock grazing. Foraging by permitted livestock (domestic foraging animals of any kind).

Maintain. In reference to an ecological condition: To keep in existence or continuance of the desired ecological condition in terms of its desired composition, structure, and processes. Depending upon the circumstance, ecological conditions may be maintained by active or passive management or both (36 CFR 219.19).

Management actions. Any alterations to ecosystems or activities that the Forest Service conducts or authorizes on National Forest System lands. These may include prescribed cutting, prescribed burning, permitted grazing, permitted fuelwood gathering, vehicular access, stream restoration treatments, seeding, trail construction, fencing, among others.

Management area. A land area identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous (36 CFR 219.19).

Management system. For the purposes of the land management planning regulation at 36 CFR 219, a timber management system including even aged management and uneven-aged management (36 CFR 219.19).

Mechanical treatment. For the purposes of this plan, mechanical treatments include most vegetation treatments except fire. They may include mechanized cutting, hand thinning, and other silvicultural treatments.

Memorandum of understanding (MOU). Describes a bilateral or multilateral agreement between two or more parties. It expresses a convergence of will between the parties, indicating an intended common line of action. It is often used in cases where parties either do not imply a legal commitment or in situations where the parties cannot create a legally enforceable agreement. It is a more formal alternative to a gentlemen's agreement.

Minimum requirements analysis. Required by law whenever land managers are considering a use prohibited by Section 4(c) of the Wilderness Act of 1964 and is a process that was developed by the Arthur Carhart National Wilderness Training Center to help land managers make informed, defensible decisions that comply with the Wilderness Act.

Mitigate. To avoid, minimize, rectify, reduce, or compensate the adverse environmental impacts associated with an action.

Mollisol. A soil of an order comprising temperate grassland soils with dark, humus-rich surface layer containing high concentration of calcium and magnesium.

Monitoring. A systematic process of collecting information to evaluate effects of actions or changes in conditions or relationships (36 CFR 219.19).

Mosaic. Mix of recurring patterns of forested and non-forested areas at the identified scale (e.g., landscape, watershed, mid-scale). Patterns are variable and may change over time.

Motor Vehicle. Any vehicle which is self-propelled, other than:

1. A vehicle operated on rails; and
2. Any wheelchair or mobility device, including one that is battery-powered, that is designed solely for use by a mobility-impaired person for locomotion, and that is suitable for use in an indoor pedestrian area (36 CFR 212.1, 36 CFR 261.2).

Motor Vehicle Use Map (MVUM). A map reflecting designated roads, trails, and areas on an administrative unit or a ranger district of the National Forest System (36 CFR 212.1).

Multiple use. The management of all the various renewable surface resources of the National Forest System so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output, consistent with the Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. 528–531) (36 CFR 219.19).

National Environmental Policy Act (NEPA). A United States environmental law (42 U.S.C. 4321 et seq.), enacted January 1, 1970, that established a national policy promoting the enhancement of the environment. Additionally, it established the President's Council on Environmental Quality (CEQ).

National Forest System. Includes National Forests, National Grasslands, and the National Tallgrass Prairie (36 CFR 219.62).

National Forest System Road. A forest road other than a road which has been authorized by a legally documented right-of-way held by a State, county or other local public road authority (36 CFR 212.1, 36 CFR 251.51, 36 CFR 261.2).

National Forest System Trail. A forest trail other than a trail which has been authorized by a legally documented right-of-way held by a State, county or other local public road authority (36 CFR 212.1).

Native species. An organism that was historically or is present in a particular ecosystem as a result of natural migratory or evolutionary processes and not as a result of an accidental or deliberate introduction into that ecosystem. An organism’s presence and evolution (adaptation) in an area are determined by climate, soil, and other biotic and abiotic factors (36 CFR 219.19).

Natural disturbance regime. The historic patterns (frequency and extent) of fire, insects, wind, landslides, floods, and other natural processes in an area.

Natural fire regime. The fire regime that existed prior to human facilitated interruption of frequency, extent, or severity.

Natural variability. A reference to past conditions and processes that provides important context and guidance relevant to the environments and habitats in which native species evolved. Disturbance driven spatial and temporal variability is vital to ecological systems. Biologically appropriate disturbances provide for heterogeneous conditions and subsequent diversity. Conversely, “uncharacteristic disturbance”, such as high-intensity fire in plant communities that historically had a frequent low intensity fire regime can have the effect of reducing diversity, increasing homogeneity, and may result in permanently altered conditions.

Neonate ungulate. Offspring of a hoofed animal (e.g., fawn or calf).

Nonindustrial wood (species). Includes aspen, junipers, piñon pines, oaks, and any industrial species cut from non-suitable timberlands. Wood cut as nonindustrial may be used as firewood or biomass.

Nutrient cycling. The circulation or exchange of elements such as nitrogen and carbon between non-living and living portions of the environment.

Objective. A concise, measurable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonably foreseeable budgets.

Off-highway vehicle (OHV). Any motorized vehicle designed for or capable of cross county travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain; except that term excludes (A) any registered motorboat, (B) any fire, military, emergency or law enforcement vehicle when used for emergency purposes, and any combat or combat support vehicle when used for national defense purposes, and (C) any vehicle whose use is expressly authorized by the respective agency head under a permit, lease, license, or contract (EO 116-44 as amended by EO 11989). See also FSM 2355. 01-Exhibit 01.

Old-growth characteristics. Old-growth forests are forests that have accumulated specific characteristics related to tree size, canopy structure, snags and woody debris and plant associations. Ecological characteristics of old-growth forests emerge through the processes of succession. Certain features – presence of large, old trees, multilayered canopies, forest gaps, snags, woody debris, and a particular set of species that occur primarily in old-growth forests – do not appear simultaneously, nor at a fixed time in stand development. Old-growth forests support assemblages of plants and animals, environmental conditions, and ecological processes that are not found in younger forests (younger than 150 years) or in small patches of large, old trees. Specific attributes of old-growth forests develop through forest succession until the collective properties of an older forest are evident.

Online. Refers to the appropriate Forest Service Website or future electronic equivalent (36 CFR 219.62).

Openings. Generally persistent treeless areas having a fairly distinct shape or size, occurring naturally due to differences in soil types as compared to sites that support forests or woodlands. Openings include meadows, grasslands, rock outcroppings, and wetlands. In contrast, created openings result from disturbances like severe fire or windthrow, or management activities to intentionally create space for new tree regeneration. Natural and created openings are not the same as interspaces found in the frequent-fire forests or woodlands. See interspaces.

Outstanding natural resource water. Streams, lakes and wetlands that receive special protection against degradation under Arizona's water quality standards and the federal Clean Water Act. They are designated by the Water Quality Control Commission. Waters eligible for outstanding natural resource water designation include waters that are part of a national or state park, wildlife refuge or wilderness areas, special trout waters, waters with exceptional recreational or ecological significance, and high-quality waters that have not been significantly modified by human activities.

Participation. Activities that include a wide range of public involvement tools and processes, such as collaboration, public meetings, open houses, workshops, and comment periods (36 CFR 219.19).

Patches. Areas larger than tree groups in which the vegetation composition and structure are relatively homogeneous. Patches compose the mid-scale; thus, they range in size from 100 to 1,000 acres.

Perennial stream. A stream or reach of a channel that flows continuously or nearly so throughout the year and whose upper surface is generally lower than the top of the zone of saturation in areas adjacent to the stream. These streams are identified as solid blue on the USGS 7 1/2-inch quadrangle maps.

Permit area. Area in which an activity is authorized through a special use permit.

Persistence. Continued existence (36 CFR 219.19).

Plan or land management plan. A document or set of documents that provide management direction for an administrative unit of the National Forest System developed under the requirements of the land management planning regulation at 36 CFR part 219 or a prior planning rule (36 CFR 219.19).

Plan area. The National Forest System lands covered by a plan (36 CFR 219.19), specifically lands managed by the Forest Service as the Tonto National Forest.

Plan components. The parts of a land management plan that guide future project and activity decision-making. Specific plan components may apply to the entire plan area, to specific management areas or geographic areas, or to other areas as identified in the plan. Every plan must include the following plan components: desired conditions, objectives, standards, guidelines, and suitability of lands. A plan may also include goals as an optional component.

Plan development. The second phase in the forest plan revision process. Plan development follows the National Environmental Policy Act process and plan revision requires preparation of an environmental impact statement. It is grounded in the information developed during the assessment phase and other information relevant to the plan area, it addresses needs for change, and it involves the public. Every plan must have management areas or geographic areas or both and may identify designated or recommended designated areas (36 CFR 219.7).

Plan monitoring program. An essential part of the land management plan that sets out the plan monitoring questions and associated indicators, based on plan components. The plan monitoring program informs management of resources on the plan area and enables the responsible official to determine if a change in plan components or other plan content that guide management of resources on the plan area may be needed.

Planned ignition. The intentional initiation of a wildland fire by hand-held, mechanical, or aerial device where the distance and timing between ignition lines or points and the sequence of igniting them is determined by environmental conditions (e.g., weather, fuel, topography), firing technique, and other factors which influence fire behavior and fire effects. See prescribed fire.

Plant and animal community. A naturally occurring assemblage of plant and animal species living within a defined area or habitat (36 CFR 219.19).

Potential natural vegetation. types comprise the “climax” vegetation that will occupy a site without disturbance or climatic change. Potential natural vegetation is an expression of environmental factors such as topography, soils, and climate across an area.

Prescribed fire. A wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which the National Environmental Policy Act requirements have been met prior to ignition.

Primitive recreation. Reliance on personal skills and nonmotorized and nonmechanized means to travel and camp in an area, rather than reliance on facilities or outside help.

Productivity. The capacity of National Forest System lands and their ecological systems to provide the various renewable resources in certain amounts in perpetuity. For the purposes of the land management planning regulation at 36 CFR part 219 and this Handbook, productivity is an ecological term, not an economic term (36 CFR 219.19).

Project. An organized effort to achieve an outcome on National Forest System lands identified by location, tasks, outputs, effects, times, and responsibilities for execution (36 CFR 219.19).

Projected timber sale quantity (PTSQ) and projected wood sale quantity (PWSQ). The projected timber sale quantity and the projected wood sale quantity are estimated amounts of timber and other wood products that are expected to be produced under the plan’s direction, based on objectives. Thus, the estimation of these two quantities must be consistent with the plan components of the final plan or the unique mix of plan components in each alternative, and the fiscal and organizational capability of the unit.

The planned management objectives for projected timber sale quantity and projected wood sale quantity are also limited based upon constraints described in FSH 1909.12, Chapter 60, section 64.32.

Proper functioning condition. Proper functioning condition is a methodology for assessing the physical functioning of riparian and wetland areas. The term proper functioning condition is used to describe both the assessment process, and a defined, on-the-ground condition of a riparian-wetland area. In either case, proper functioning condition defines a minimum or starting point.

Proposed species. Any species of fish, wildlife, or plant that is proposed by the U. S. Fish and Wildlife Service or the National Marine Fisheries Service in the Federal Register to be listed under Section 4 of the Endangered Species Act. (36 CFR 219.19)

Range condition. A subjective expression of the status or health of the vegetation and soil relative to their combined potential to produce a sound and stable biotic community. (USDA Forest Service, Southwestern Region, Record of Decision for Amendment of Forest Plans, Arizona and New Mexico). It is evaluated relative to desired conditions.

Rangelands. Forage-producing forested and non-forested lands.

Recommended wilderness. An area within the National Forest System which has been recommended for official designation by the regional forester to the Chief of the Forest Service. The Chief may elect to forward the recommendation with wording for a congressional bill to the Secretary of Agriculture, who may then elect to transmit the proposed bill to Congress. It takes an act of Congress to designate a wilderness area.

Recovery. For the purposes of the land management planning regulation at 36 CFR part 219 and with respect to threatened or endangered species: The improvement in the status of a listed species to the point at which listing as federally endangered or threatened is no longer appropriate (36 CFR 219.19).

Recreation opportunity. An opportunity to participate in a specific recreation activity in a particular recreation setting to enjoy desired recreation experiences and other benefits that accrue. Recreation opportunities include nonmotorized, motorized, developed, and dispersed recreation on land, water, and in the air (36 CFR 219.19).

Recreation setting. The social, managerial, and physical attributes of a place that, when combined, provides a distinct set of recreation opportunities. The Forest Service uses the recreation opportunity spectrum to define recreation settings and categorize them into six distinct classes: primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, rural, and urban (36 CFR 219.19).

Redundancy. The presence of multiple occurrences of ecological conditions such that not all occurrences may be eliminated by a catastrophic event.

Reference conditions. Environmental conditions that infer ecological sustainability. When available, reference conditions are represented by the characteristic natural range of variation (not the total range of variation), prior to European settlement and under the current climatic period. For many ecosystems, natural range of variation also reflects human-caused disturbance and effects prior to settlement. It may also be necessary to refine reference conditions according to contemporary factors (e.g., invasive species) or projected conditions (e.g., climate change). Reference conditions are most useful as an inference of sustainability when they have been quantified by amount, condition, spatial distribution, and temporal variation.

Regulated timber harvest. Tree harvest for the purposes of timber production, as opposed to tree harvest for other purposes, such as habitat and watershed improvement or fuelwood.

Rehabilitate. Reestablish the natural landscape, ecosystem, or artificial improvements through sustainable ecological, social, or economic management practices based off the activity and use in the area. Examples include planting seed and small vegetation in an area that has experienced soil compaction and vegetation trampling from vehicles where there are no designated roads or motorized trails.

Representativeness. The presence of a full array of ecosystem types and successional states, based on the physical environment and characteristic disturbance processes.

Research natural areas. A physical or biological unit in which current natural conditions are maintained insofar as possible. These conditions are ordinarily achieved by allowing natural physical and biological processes to prevail without human intervention. Research natural areas are principally for non-manipulative research, observation, and study. They are designated to maintain a wide spectrum of high-quality representative areas that represent the major forms of variability found in forest, shrubland, grassland, alpine, and natural situations that have scientific interest and importance that, in combination, form a national network of ecological areas for research, education, and maintenance of biological diversity.

Resilience. The ability of an ecosystem and its component parts to absorb, or recover from the effects of disturbances through preservation, restoration, or improvement of its essential structures and functions and redundancy of ecological patterns across the landscape.

Responsible official. The official with the authority and responsibility to oversee the planning process and to approve a plan, plan amendment, and plan revision (36 CFR 219.62).

Restoration, ecological. The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystems sustainability, resilience, and health under current and future conditions (36 CFR 219.19).

Restore. To renew by the process of restoration. See restoration (36 CFR 219.19).

Riparian areas. Three-dimensional ecotones [the transition zone between two adjoining communities] of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths (36 CFR 219.19).

Riparian management zone. The interface between land and a river or stream. Plant habitats and communities along the river margins and banks are called riparian vegetation, characterized by hydrophilic plants.

Risk. A combination of the likelihood that a negative outcome will occur and the severity of the subsequent negative consequences (36 CFR 219.19).

Road. A motor vehicle route over 50 inches wide, unless identified and managed as a trail (36 CFR 212.1).

Road decommissioning. Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212.1). It includes a range of activities from ripping and seeding to full reclamation by restoring the original topography. Road decommissioning results in the removal of a National Forest System road from the forest transportation atlas.

Road Maintenance Levels (ML):

- ML1. Roads that are closed to vehicular traffic intermittently for periods that exceed 1 year. Can be operated at any other maintenance level during periods of use.
- ML2. Roads that are open and maintained for use by high-clearance vehicles; surface smoothness is not a consideration. Most have native material surface (not paved and no aggregate surface).
- ML3. Roads that are open and maintained for use by standard passenger cars. Most have gravel surface.
- ML4. Roads that are open and maintained for use by standard passenger cars and to provide a moderate degree of user comfort and convenience at moderate travel speeds. Most are paved or have an aggregate surface.
- ML5. Roads that are open and maintained for use by standard passenger cars

Routine maintenance. Work that is planned to be accomplished on a continuing basis, generally annually or more frequently (FSH 7709.58, 13.41).

Scale. Desired conditions are described at multiple scales where appropriate. Descriptions at various scales are sometimes necessary to provide adequate detail and guidance for the design of future projects and activities that will help achieve the desired conditions over time. The three scales used in this plan are:

- Fine scale is an area 10 acres or less in size at which the distribution of individual trees (single, grouped, or aggregates of groups) is described. Fine-scale desired conditions provide the view that can be observed standing in one location on the ground. Fine-scale desired conditions typically contain greater variability, which is desirable for providing heterogeneity at smaller spatial scales.
- Mid-scale desired conditions are composed of assemblages of fine-scale units and have descriptions that would be averaged across areas of 100- to 1,000-acre units.
- Landscape scale is an assemblage of 10 or more mid-scale units, typically totaling more than 10,000 acres, composed of variable elevations, slopes, aspects, soils, plant associations, and disturbance processes. Landscape scale desired conditions provide the big picture overview with resolution that would, for example, be observable from an airplane or from a zoomed-out Google Earth view. The landscape scale is also appropriate scale for describing fewer common components that would not necessarily occur on every mid-scale unit within the landscape.

Scenery management system. A classification system that recognizes scenery as the visible expression of dynamic ecosystems functioning within “places”, which have unique aesthetic and social values. It recognizes that in addition to naturally occurring features, positive scenery attributes associated with social, cultural, historical, and spiritual values, including human presence and the built environment, can also be valued elements of the scenery. The scenery management system also allows for “seamless” analysis and conservation beyond National Forest System lands into adjacent communities and other jurisdictions, through the application of varying scenery “themes” within a single analysis. It is structured to emphasize "natural appearing” scenery.

Scenic character. A combination of the physical, biological, and cultural images that gives an area its scenic identity and contributes to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity (36 CFR 219.19).

Scenic integrity objective. A desired level of excellence based on physical and sociological characteristics of an area. Refers to the degree of acceptable alterations to the valued attributes of the characteristic landscape. Objectives include very high, high, moderate, and low.

Seral stage (seral state). One of a series of transitional plant communities that develop during gradual successive change following disturbance.

Silviculture. The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands using species silvics to meet the diverse needs and values of landowners and society on a sustainable basis. Under this definition, silvicultural treatments include all management activities that control the establishment, growth, composition, health, and quality of forested lands to achieve stated land management objectives. The use of prescribed fire on forested lands qualifies as a silvicultural treatment in the context of this definition.

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

Soil condition rating. A qualitative rating developed within the Southwestern Region of the Forest Service that provides an overall picture of soil condition vital in sustaining ecosystems. It is based on three soil functions: the ability of soil to resist erosion, infiltrate water, and recycle nutrients. There are four soil condition ratings:

- Satisfactory. Soil function is being sustained and soil is functioning properly and normally.
- Impaired. The ability of the soil to function properly and normally has been reduced or there exists an increased vulnerability to degradation.
- Unsatisfactory. Degradation of vital soil functions result in the inability of the soil to maintain resource values, sustain outputs or recover from impacts.
- Inherently unstable. These soils are eroding faster than they are renewing themselves.

Soil disturbance. When the soil no longer functions because of the loss of surface organic material (affecting nutrient cycling), compaction (affecting regulation and partitioning of water and air flow), and severe burn (affecting nutrient cycling and biology), then soil disturbance has occurred.

Soil productivity. The inherent capacity of the soil to support appropriate site-specific biological resource management objectives, which includes the growth of specified plants, plant communities, or a sequence of plant communities to support multiple land uses.

Species of conservation concern. A species, other than federally recognized threatened, endangered, proposed, or candidate species, which is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area (36 CFR 219.9(c)).

Species diversity. Abundance of different species (both plant and animal) on the Tonto National Forest and adjoining lands; species richness. The National Forest Management Act requires that land management plans provide for diversity of plant and animal communities.

Stand. A contiguous group of trees generally uniform in age class distribution, composition, condition, and structure, and growing on a site of generally uniform quality, to be a distinguishable unit, such as mixed, pure, even-aged, and uneven-aged stands. A stand is the fundamental unit of silviculture reporting and record keeping.

Standard. A mandatory constraint on project and activity decision-making, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Stressors. For the purposes of the land management planning regulation at 36 CFR part 219, factors that may directly or indirectly degrade or impair ecosystem composition, structure, or ecological process in a manner that may impair its ecological integrity, such as an invasive species, loss of connectivity, or the disruption of a natural disturbance regime (36 CFR 219.19).

Sub-watershed. A HUC 12 hydrologic unit, the smallest subdivision considered in this assessment.

Suitable timberlands. Land to be managed for timber production on a regulated basis. Such lands are those which have been determined to meet the following criteria: (a) are available for timber production (i.e., not withdrawn for wilderness or other official designation by Congress, the Secretary of Agriculture, or Chief of the Forest Service); (b) are physically capable of producing crops of industrial wood without irreversible resource damage to soils productivity or watershed conditions; (c) adequate tree restocking within 5 years of final harvest is reasonably assured; (d) adequate information exists about responses to timber management activities; (e) timber management is cost efficient over the planning horizon in meeting forest objectives that include timber production; (f) timber production is consistent with meeting the management requirements and multiple use objectives specified in the forest plan or plan alternative; and (g) other management objectives do not limit timber production activities to the point where it is impossible to meet management requirements set forth in 36 CFR § 129.27 (per FSH 2409.13, WO Amendment 2409.13-92-1, O Code and Chapter 20).

Sustainability. The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. For the purposes of the land management planning regulation at 36 CFR part 219 and this Handbook ‘‘ecological sustainability’’ refers to the capability of ecosystems to maintain ecological integrity; ‘‘economic sustainability’’ refers to the capability of society to produce and consume or otherwise benefit from goods and services including contributions to jobs and market and nonmarket benefits; and ‘‘social sustainability’’ refers to the capability of society to support the network of relationships, traditions, culture, and activities that connect people to the land and to one another, and support vibrant communities (36 CFR 219.19).

Sustainable recreation. The set of recreation settings and opportunities on the National Forest System that is ecologically, economically, and socially sustainable for present and future generations (36 CFR 219.19).

Sustainable Yield Limit. The sustained yield limit is an estimate of the amount of commercial wood products that may be sustainably harvested over a long period of time.

Systems (Of Trails). A group or collection of trails or roads that are interconnected, defined access points, similar recreation destination values.

Temporary road or trail. 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 a forest transportation atlas (36 CFR 212.1).

Terrestrial ecosystem. All interacting organisms and elements of the abiotic environment in those vegetation and soil types, which are neither aquatic nor riparian.

Terrestrial ecosystem survey. An inventory of soil types or terrestrial ecosystem units on the Tonto National Forest. It contains predictions and limitations of soil and vegetation behavior for selected land uses. This survey also highlights hazards or capabilities inherent in the soil and the impact of selected uses on the environment. At the context scale, upland ecological response units are derived from the Tonto National Forest Terrestrial Ecosystem Survey (USDA Forest Service 2014a).

Terrestrial ecosystem unit. The classification unit used in the terrestrial ecosystem survey. A spatially explicit area with a similar combination of soils, land types, and vegetation c Threatened species. Any species that the Secretary of the Interior or the Secretary of Commerce has determined is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Threatened species are listed at 50 CFR sections 17.11, 17.12, and 223.102.

Thinning. An intermediate treatment made to reduce the stand density of trees primarily to improve growth, enhance forest health, recover potential mortality, emphasize desired tree species, and/or emphasize desired forest structure. Thinning methods include:

- Single tree selection is used in uneven-aged silvicultural systems in which scattered individual trees of multiple size and/or age classes are removed throughout the stand to achieve desired structural characteristics.
- Group selection is a method of regenerating uneven-aged stands in which trees are removed, and new age classes are established, in small groups. Small openings provide micro-environments suitable for tolerant regeneration and the larger openings provide conditions suitable for more intolerant regeneration. In the group selection system, the management unit or stand in which regeneration, growth, and yield are regulated consists of a landscape containing an aggregation of groups.
- Sanitation cutting is the removal of dead, dying, or damaged trees to prevent or interrupt the spread of insects or disease.
- Salvage cutting is the removal of trees that have been killed or damaged by wildland fire, severe wind, insects or disease, or other natural disturbances.
- Even-aged regeneration is a cutting method by which a new stand with a single age class is created.
- Matrix thinning is the thinning of the “matrix” of trees outside of a regeneration area. The matrix is generally thinned from below to some specified density in order to increase stand vigor and resiliency.
- All-size free thinning is the removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position.
- Thinning from below is the removal of trees from lower canopy positions while retaining the largest and most vigorous trees with the best-developed crowns.

Timber harvest. The removal of trees for wood fiber use and other multiple use purposes (36 CFR 219.19).

Timber production. The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (36 CFR 219.19).

Traditional community. A land-based rural community that has a long-standing history in and around the lands managed by the Forest Service.

Traditional cultural property (TCP). A property that is eligible for inclusion in the National Register of Historic Places (NRHP) based on its associations with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community.

Tribal consultation. The timely, meaningful, and substantive dialogue between Forest Service officials who have delegated authority to consult, and the official leadership of federally recognized Indian Tribes, or their designated representatives, pertaining to USDA Forest Service policies that may have Tribal implications.

Tree Size. The diameter of the bole of a tree measured at breast height (dbh).

- Seedling/Sapling: 0.0 to 4.9 inches diameter
- Small tree: 5.0 to 9.9 inches diameter
- Medium tree: 10 to 19.9 inches diameter
- Large tree: at least 20.0 inches diameter

Uncharacteristic wildfire. An increase in wildfire size, severity, and resistance to control compared to reference conditions which occurred historically. These fires result as a consequence of more continuous canopy cover, ladder fuels, and accumulated live and dead woody material. Uncharacteristic wildfires burn with more intensity; cause higher tree mortality; degrade watersheds; sterilize soils; and threaten adjacent communities, forest infrastructure, and wildlife habitat. See reference conditions.

Uneven-aged forests. Forests composed of three or more distinct age classes of trees, either intimately mixed or in small groups.

Uneven-aged management. The application of a combination of actions needed to simultaneously maintain continuous high forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

Ungulate. A hooved animal, which includes wildlife (e.g., pronghorn, deer, and elk) and domestic livestock (e. g., sheep, cattle, and horses).

Unneeded trails. Trails that are unsustainable, low use, have no remarkable destination value, or are duplicate trails to the same destination.

Unplanned ignition. The initiation of a wildland fire by lightning or unauthorized and accidental human-caused fires. See wildfire.

Upland. May refer to areas, species, systems, or conditions that are characteristic of terrestrial ecosystems, as opposed to riparian or aquatic ecosystems.

Values to be protected (values at risk). Includes property; structures; physical improvements; natural and culture resources; community infrastructure; and economic, environmental, and social values.

Vegetation Dynamics Development Tool is a software program that provides a state and transition modeling framework to examine the role of various transition agents and the effects of management actions that alter vegetative communities (ESSA Technologies Ltd. 2006).

Vegetation state refers to a combination of the dominant plan canopy cover class and (for forest and woodland) size class and density class within a potential natural vegetation type. See also seral state.

Vegetation structure. Structure includes both the vertical and horizontal dimensions of a vegetation type or plant community. The horizontal structure refers to spatial patterns of individual and groups of plants and openings, as well as plant size and species composition. The vertical component refers to the layers of vegetation between the forest floor and the top of the canopy. Each vegetation type has its own structure. For example, forests have greater vertical structure than a grassland or woodland based on the height of the dominant species.

Viable population. A population of a species that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments.

Vigor. Relates to the relative robustness of a plant in comparison to other individuals of the same species. It is reflected primarily by the size of a plant (i.e., height, weight) and its parts in relation to its age and the environment in which it is growing.

Watershed. A region or land area drained by a single stream, river, or drainage network; a drainage basin (36 CFR 219.19). Specifically, a HUC 10 hydrologic unit, larger than a sub-watershed, and nested in a sub-basin.

Watershed condition. The state of a watershed based on physical and biogeochemical characteristics and processes (36 CFR 219.19).

Wetlands. A specific subtype within the Wetland Riparian group of vegetation communities. In wetlands saturation with water is the dominant factor determining the nature of soil development and plant and animal communities. "For regulatory purposes under the Clean Water Act, the term wetlands means 'those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.' [taken from the EPA Regulations listed at 40 CFR 230.3(t)]." (Code of Federal Regulation. 2015. 33 CFR 328.3(c)(16), Wetlands. 83 FR 5208. June 29, 2015) The Wetland Riparian vegetation community as defined in this plan is slightly more inclusive and includes open water wetlands and cienegas that may not be considered wetlands for regulatory purposes.

Wild and Scenic River. A river designated by Congress as part of the National Wild and Scenic Rivers System that was established in the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 (note), 1271–1287) (36 CFR 219.19).

- Wild – Those rivers or segments of rivers free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive, and waters unpolluted. These represent vestiges of primitive America.
- Scenic – Those rivers or segments of rivers free of impoundments, with shorelines or watersheds still largely primitive, and shorelines largely undeveloped but accessible in places by roads.

- Recreational – Those rivers or segments of rivers readily accessible by road or railroad, which may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Wilderness. Any area of land designated by Congress as part of the National Wilderness Preservation System that was established in the Wilderness Act of 1964 (16 U.S.C. 1131–1136) (36 CFR 219.19).

Wildfire. Unplanned ignition of a wildland fire (e.g., fires caused by lightning or unauthorized and accidental human-caused fires) and escaped prescribed fires. See unplanned ignition.

Wildfire hazard. A fuel complex, defined by volume, type condition, arrangement, and location, which determines the degree or ease of ignition and of resistance to control.

Wildland. An area in which development is essentially nonexistent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered.

Wildling. A native plant growing uncultivated in the wild: specifically, the collection or transplant of such whole live plants.

Wildland fire. A general term describing any non-structure fire that occurs in the vegetation and/or natural fuels. The two types of wildland fire are wildfires and prescribed fires. Other terms such as “fire-use fires,” “resource benefit fires,” or “suppression fires” are not used in this plan.

Wildland-urban interface. That area where human development adjoins public or private natural areas, or an intermix of rural and urban land uses. From a natural resource perspective, the wildland-urban interface is an area where increased human influence and land-use conversion are changing natural resource goods, services, and management techniques (Andreu and Hermansen-Baez 2008).

Windthrow. Trees susceptible to wind damage (e.g., uprooting, toppling, bole breakage).

Woodland. Lands with over 10 percent tree canopy cover where the majority of the trees are non-timber species (e.g., piñon pine and juniper) not traditionally used for industrial wood products.

Woody biomass. The trees and woody plants, including limbs, tops, needles, leaves, and other woody parts, grown in a forest, woodland, or grassland environment, which are the byproducts of forest management used to produce bioenergy and the full range of bio-based products

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Index

E

F

G

N

O

P

R

S

Y