Four Forest Restoration Initiative – Rim Country

Aquatics Specialist Report

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For:
Lakeside and Black Mesa Ranger Districts, Apache-Sitgreaves National Forests
Payson and Pleasant Valley Ranger Districts, Tonto National Forest
Red Rock and Mogollon Ranger Districts, Coconino National Forest

Date: 11/02/2018

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Introduction

This report evaluates and discloses the potential environment consequences to aquatic biota and habitat (including federally listed, candidate species, Forest Service sensitive species, and aquatic management indicator species (MIS) from the alternatives proposed for the Four Forest Restoration Initiative – Rim Country Analysis Area. This report also provides a summary of the identification and descriptions of the endangered, threatened, and sensitive aquatic species and their occupied, critical, and recovery habitats that occur within the planning area.

This specialists report is being prepared for the National Environmental Policy Act document, which is the Final Environmental Impact Statement (FEIS) for the *Rim Country Restoration Project.* The report does not replicate the complete descriptions for the purpose and need, proposed action, and alternatives; as these are disclosed and discussed in detail within chapters one and two of the FEIS for the Rim Country Restoration Project (hereinafter referred to as Rim Country).

Relevant Laws, Regulations, and Policy

Regulatory Framework

Land and Resource Management Plans

The Apache-Sitgreaves, Tonto, and Coconino National Forest Land Management Plans (LMP) provide desired conditions, objectives, standards and guidelines for forest restoration and aquatics species/habitats. The Apache-Sitgreaves and Coconino NFs have new LMPs; while the Tonto is currently working under their 1985 Forest Plan while undergoing Plan Revision.

In order to achieve overall ecosystem health and provide for species diversity and viability, the primary emphasis of the Land Management Plans (LMPs) is, over time, to achieve satisfactory watershed conditions and restore ecological function, especially fire regimes. The focus for implementing LMP objectives is desired conditions, while individual projects and activities maintain or incrementally move current conditions toward or maintain desired conditions (as shaped by applicable standards and guidelines). Appendix A includes a list of all the desired conditions, standards, and guidelines within the LMPs related to aquatic species and their habitats and summarizes any impacts resulting from the proposed action.

The LMPs provide standards and guidelines for aquatic species and habitat under various section of the Forest Plans. Applicable Standards and Guidelines in relation to this report are list below in Table 1. All Forest Plan components (Desired Conditions, Standards, and Guidelines) can be found in Appendix A.

Table 1. Forest Land Management Plan Standards and Guidelines for forest restoration projects in aquatic and riparian habitats by Forest.

Forest Plan Section	Standard (ST), and Guideline (GL).
Apache-Sitgreaves National Forests	
Water Resources	**GL:** Projects with ground-disturbing activities should be designed to minimize long and short term impacts to water resources. Where disturbance cannot be avoided, project specific soil and water conservation practices and best management practices (BMPs) should be developed.

	GL: Streams, stream banks, shorelines, lakes, wetlands, seeps, springs, and other bodies of water should be protected from detrimental changes in water temperature and sediment to protect aquatic species and riparian habitat. **GL:** Aquatic management zones should be in place between streams and disturbed areas and/or road locations to maintain water quality and suitable stream temperatures for aquatic species. **GL:** To protect water quality and aquatic species, heavy equipment and vehicles driven into a water body to accomplish work should be completely clean of petroleum residue. Water levels should be below the gear boxes of the equipment in use. Lubricants and fuels should be sealed such that inundation by water should not result in leaks.
Aquatic Habitat and Species	**ST:** When drafting (withdrawing) water from streams or other water bodies, measures will be taken to prevent entrapment of fish and aquatic organisms and the spread of parasites or disease (e.g., Asian tapeworm, chytrid fungus, whirling disease). **GL:** Management activities should not contribute to a trend toward the Federal listing of a species. **GL:** Activities occurring within federally listed species habitat should apply habitat management direction and species protection measures from recovery plans. **GL:** To prevent degradation of native species habitat and the incidental or accidental introduction of diseases or nonnative species, aquatic species should not be transferred through management activities from one 6th level HUC watershed to another. **GL:** Sufficient water should be left in streams to provide for aquatic species and riparian vegetation. **GL:** Projects and activities should avoid damming or impounding free-flowing waters to provide streamflows needed for aquatic and riparian-dependent species. **GL:** The needs of rare and unique species associated with wetlands, fens, bogs, and springs should be given priority consideration when developing these areas for waterfowl habitat and other uses.
All PNVTs	**ST:** Vegetation treatments shall include measures to reduce the potential for introduction of invasive plants and animals and damage from nonnative insects and diseases. **GL:** During project design and implementation, precautions should be taken to reduce the potential for damage to residual vegetation in order to prevent premature or excessive mortality. **GL:** Landscape scale restoration projects should be designed to spread treatments out spatially and/or temporally within the project area to reduce implementation impacts and allow reestablishment of vegetation and soil cover. **GL:** Restoration methods, such as thinning or prescribed fire, should leave a mosaic of untreated areas within the larger treated project area to allow recolonization of treated areas by plants, small mammals and insects (e.g. long-tailed voles, fritillary butterflies). **GL:** Projects should include quantitative and/or qualitative objectives for implementation monitoring and effectiveness monitoring to assist in moving toward or maintaining desired conditions.
Riparian Areas	**GL:** Ground-disturbing projects (including prescribed fire) which may degrade long term riparian conditions should be avoided. **GL:** Wet meadows, springs, seeps and cienegas should not be used for concentrated activities (e.g. equipment storage, forest product or mineral stockpiling, livestock handling facilities, special uses) that cause damage to soil and vegetation. **GL:** Storage of fuels and other toxicants should be located at least 100 feet outside of riparian areas to prevent spills that could impair water quality or harm aquatic species.

	GL: Equipment should be fueled or service areas should be located at least 100 feet outside of riparian areas to prevent spills that could impair water quality or harm aquatic species. **GL:** Construction or maintenance equipment service areas should be located at least 100 feet from riparian areas, and treated to prevent gas, oil, and other contaminants from washing or leaching into streams.
Ponderosa Pine and Dry Mixed Conifer	**GL:** Where consistent with project or activity objectives, canopy cover should be retained on the south and southwest sides of small, existing forest openings that are naturally cooler and moister. These small (generally one-tenth to one-quarter acre) shaded openings provide habitat conditions needed by small mammals, plants, and insects (e.g., Merriam's shrew, Mogollon clover, four-spotted skipperling butterfly). Where these openings naturally occur across a project area, these conditions should be maintained on an average of 2 or more such openings per 100 acres.
Wildlife and Rare Plants	**GL:** Modifications, mitigations, or other measure should be incorporated to reduce negative impacts to plants, animals, and their habitats and to help provide for species needs, consistent with project activity or objectives. **GL:** Rare and unique features (e.g. talus slopes, cliffs, canyon slopes, caves, fens, bogs, sinkholes) should be protected from damage or loss in order to maintain their distinctive ecological functions and maintain viability of associated species. **GL:** The needs of localized species (e.g. New Mexico meadow jumping mouse, Bebb willow, White Mountains paintbrush) should be considered and provided for during project activities to ensure their limited or specialized habitats are not lost or degraded. **GL:** Constructed features should be maintained to support the purpose(s) for which they are built. Constructed features should be removed when no longer needed.
Invasive Species	**ST:** Projects and authorized activities shall be designed to reduce the potential for introduction of new species or spread of existing invasive or undesirable aquatic or terrestrial nonnative populations. **GL:** Projects and activities should not transfer water between drainages or between unconnected water bodies within the same drainage to avoid spreading disease and aquatic invasive species. **GL:** Project areas should be monitoring to ensure there is no introduction or spread of invasive species.
Overall Recreation Opportunities	**GL:** Constructed features should be maintained to support the purpose(s) for which they were built. Constructed features should be removed when no longer needed.
Motorized Opportunities	**ST:** Temporary road construction shall minimize the impacts to resource values and facilitate road rehabilitation. Temporary roads shall be rehabilitated following completion of the activities for which they were constructed. **ST:** Road maintenance and construction activities shall be designed to reduce sediment (e.g., water bars, sediment traps, grade dips) while first providing for user safety. **GL:** As projects occur in riparian or wet meadow areas, unneeded roads or motorized trails should be closed or relocated, drainage restored, and native vegetation reestablished to move these areas toward their desired condition. **GL**: As projects occur, redundant roads or motorized trails should be removed to reduce degradation of natural resources. **GL:** Roads and motorized trails removed from the transportation network should be treated in order to avoid future risk to hydrologic function and aquatic habitat. **GL:** Roads and motorized trails should be designed and located so as to not impede terrestrial and aquatic species movement and connectivity.

	GL: As projects occur, existing meadow crossings should be relocated or redesigned, as needed, to maintain or restore hydrologic function using appropriate tools such as French drains and elevated culverts. **GL:** After management activities occur in areas with high potential for cross-country motorized vehicle use, methods (e.g., barriers, signing) should be used to control unauthorized motorized use.
Nonmotorized Opportunities	**GL:** New trails and trail relocations should be designed and located so as to not impede terrestrial and aquatic species movement and connectivity. **GL:** Meadow crossings should be designed or redesigned to maintain or restore hydrologic function using appropriate tools such as French drains and elevated culverts.
Minerals and Geology	**GL:** Existing designated mineral material collection areas and community pits should be utilized to the maximum before new areas are developed. Additional mineral material development should balance private and community needs while providing for sustainable administrative use. **GL:** Abandoned mine lands or unneeded mineral material pits should be restored, closed, or rehabilitated to provide for resource protection and public health and safety. **GL:** Common variety mineral activities should not be permitted in designated or recommended special areas or Chevelon Canyon to protect the unique character of these areas.
Tonto National Forest	
Fire Management	**S&G (management areas 1F, 4D, 4F):** Use prescribed fire to treat vegetation for water yield, forage, and wildlife habitat improvement
Forestry and Forest Health	**S&G (management area 4D, 5D):** Timber sale road systems should be designed to minimize impacts on stream channels and water quality. Roads should be located on slopes less than 60%, and should have sustained gradients of less than 8%. Roads should not be located on unstable slopes where mass movement is likely to occur. **S&G (management area 4D):** An Interdisciplinary (I.D.) team will evaluate the need for buffer strips adjacent to water bodies within proposed commercial saw timber sale areas. Where a buffer strip is deemed necessary, the I.D. team will recommend the width of strip needed to achieve adequate protection of aquatic and riparian resources. The width of the buffer strip will depend upon such factors as channel stability, side-slope steepness, erodibility of soils, existing ground cover conditions, and existing aquatic conditions. Logging vehicles will not be allowed to operate within any such designated buffer strips, except at designated crossings. **S&G (management area 4D, 5D):** Slash and debris should be kept out of protected stream channels. **S&G (management area 4D, 5D):** Raise lead end of logs when skidding to minimize gouging. Restrict skidding during wet weather if necessary to prevent watershed damage. Rehabilitate skid trails and landings when logging is completed (provide drainage, repair ruts and gullies, and seed if necessary).
Rangeland Management	**S&G (management area 4D, 5D)**: Wildlife habitat improvement needs will be integrated into range forage improvement projects identified in approved AMPs. Habitat improvement opportunities will also be integrated with timber management activities.
Watershed Management	**S&G:** Cooperate fully with the State Department of Health Services (Division of Environmental Health), and with the Arizona Water Quality Control Council to reduce or eliminate pollution of the river. **S&G (Wild and Scenic River mgmt. areas):** Preserve the free-flowing condition of this river (free-flowing is defined by law as: existing or flowing in a natural condition without

	impoundment, diversion, straightening, rip-rapping, or other modifications of waterway). Retention of minor structures which existed at the time of designation may be permitted.
Wildlife, Fish, and Rare Plants	**S&G:** Identify, survey, map, and analyze habitat for all Federally-listed species. Identify management conflicts and enhancement opportunities. Correct any management conflicts or problems. **S&G:** Continue to clear all projects for threatened, endangered, proposed, and candidate plant and animal species. Clearances will be done by Wildlife Biologist and reviewed by Forest Biologist. **S&G:** Initiate informal or formal consultation, as required by the ESA, with the USFWS on all actions that effect T&E plant and animal species **S&G:** New additions of listed, proposed or candidate species by the US Fish and Wildlife Service will be protected. **S&G:** Maintain a minimum of 30% effective ground cover for watershed protection and forage production, especially in primary wildlife forage producing areas. Where less than 30% exists, it will be the management goal to obtain a minimum of 30% effective ground cover. **S&G:** Habitat requirements for endangered species will have precedence over threatened species. **S&G:** All Riparian Areas- Rehabilitate and maintain, through improved management practices, mixed broadleaf riparian to achieve 80% of the potential overstory crown coverage. Natural regeneration is anticipated to achieve most of this goal. Artificial regeneration may be necessary in some areas. **S&G:** Re-establish riparian vegetation in severely degraded but potentially productive riparian areas. Natural regeneration is anticipated to achieve this goal, but artificial regeneration may be necessary in some areas. **S&G:** Survey, study and assess the status of candidate species on a priority basis. Identify document and correct any management conflicts to the species or their habitats. **S&G:** Manage riparian areas to the level needed to provide protection and improvement. **S&G:** Where possible, locate roads on natural benches, ridges, flat slopes near ridges or valley bottoms, and away from stream channels. **S&G:** Where channel crossings are necessary, select an area where the channel is straight and cross the channel at right angles. **S&G:** In streams inhabited by fish, structures need to provide for fish passage. In addition, structures containing natural stream bottoms are preferred over culverts. **S&G:** Avoid channel changes or disturbance of stream channels and minimize impacts to riparian vegetation. **S&G (1996 amendments):** Riparian Areas: Emphasize maintenance and restoration of healthy riparian ecosystems through conformance with forest plan riparian standards and guidelines. Management strategies should move degraded riparian vegetation toward good condition as soon as possible. Damage to riparian vegetation, stream banks, and channels should be prevented. **S&G (1996 amendments):** Basin and Range - West: Emphasize restoration of lowland riparian habitats. **S&G (1996 amendments):** Monitoring and evaluation should be collaboratively planned and coordinated with involvement from each national forest, USFWS Ecological Services Field Office, USFWS Regional Office, USDA Forest Service Regional Office, Rocky Mountain Research Station, recovery team, and recovery unit working groups.

	S&G (1996 amendments): Manage the ground surface layer to maintain satisfactory soil conditions i.e., to minimize soil compaction; and to maintain hydrologic and nutrient cycles. **S&G (1996 amendments):** When activities conducted in conformance with these standards and guidelines may adversely affect other threatened, endangered, or sensitive species or may conflict with other established recovery plans or conservation agreements; consult with the USFWS to resolve the conflict. **S&G (1996 amendments):** Manage road densities at the lowest level possible. Where timber harvesting has been prescribed to achieve desired forest condition, use small skid trails in lieu of roads.
Coconino National Forest	
Watersheds and Water	**GL:** Watersheds should have enough vegetative ground cover to recover rapidly from natural and human disturbances and to maintain long-term soil productivity. **GL:** Watershed restoration and maintenance, and vegetation treatments should focus on priority 6th code watersheds to ensure that ecosystem processes, resilient vegetation conditions, and natural disturbance regimes are functioning properly. **GL:** Best management practices for management activities should be identified, implemented, and monitored to maintain water quality, quantity, and timing of flows, and to prevent or reduce accelerated erosion. **GL:** Within existing water rights, excess water should remain in or be allowed to flow freely back into the natural channel, spring, and riparian habitat to maintain and improve ecological function, water quality, quantity, and timing of flows, and to benefit native species and their habitat.
Constructed Waters	**GL:** For new projects and management activities, a site-specific aquatic management zone should be identified and maintained around reservoirs to protect water quality and to avoid detrimental changes in water temperature or chemical composition, blockages of streamcourses, or sediment deposits that would seriously and adversely affect water conditions or aquatic habitat. Soil and vegetation disturbance from management activities should be minimized to meet this intent, but is not necessarily excluded in this zone. **GL:** Earthen stock ponds determined to be important for threatened, endangered, and Southwestern Region sensitive species, should be managed to maintain water and habitat needed for species' survival and reproduction, consistent with existing water rights.
All Riparian Areas	**GL:** Management activities such as vegetation treatments or other restoration actions should be designed to maintain or move toward desired conditions for other uses and resources. **GL:** Riparian areas should be managed to promote natural movement of water and sediment, to maintain ecological functions, and to maintain habitat and corridors for species. **GL:** An aquatic management zone should be identified and maintained in riparian areas to protect water quality and to avoid detrimental changes in water temperature or chemical composition, blockages of stream courses, or sediment deposits that would seriously and adversely affect water conditions, fish habitat, or connected downstream cave, karst, and lava tube resources. Soil and vegetation disturbance from management

	activities should be managed to meet these intents, but is not necessarily excluded in this zone.
Stream Ecosystems	**GL:** In perennial and intermittent riparian stream courses, projects and management activities should be designed and implemented to retain or restore natural streambank stability, native vegetation, and riparian and soil function. **GL:** An aquatic management zone for non-riparian, intermittent stream courses should be identified and maintained to reduce sedimentation, maintain functioning of the channel within its floodplain, and maintain downstream water quality and riparian habitat and function. This management zone would also avoid detrimental changes in water temperature or chemical composition; blockages of stream courses; or sediment deposits that would seriously and adversely affect water conditions, fish habitat, or connected downstream cave, karst, and lava tube resources. Soil and vegetation disturbance from management activities should be managed to meet these intents, but is not necessarily excluded in this zone.
Springs	**GL:** Spring recharge areas, where known, should be managed to maintain or improve spring discharge. **GL:** Projects and activities should be designed and implemented to maintain or improve soil and riparian function; maintain or improve native vegetation; and/or prevent the introduction or spread of disease, invasive, or undesirable species. Design features could include road, recreation, and/or livestock management. **GL:** Where there is a structure in place to use water from a spring as a water source or when designing restoration projects, priority should be given to the protection of spring source areas and riparian habitat to safeguard the unique ecological and biophysical characteristics, higher biodiversity, endemic species, and cultural values associated with spring sources. For example, water could be piped out of the riparian area to avoid negative impacts to soil, water, and vegetation or if water is to be diverted, a flow-splitter could be installed to maintain some flow at the source.
Riparian Forest Types	**GL:** Connectivity within the unique vegetation community created by the combination of lower elevation riparian forests, and mesquite bosques should be maintained and enhanced. The intent is to maintain ecological functions, tree density, and growth, native understory, and reduce the risk of predation and nest parasitism and to provide habitat for western yellow-billed cuckoo, Bell's vireo, and other wildlife species. **GL:** In riparian forests, recreation activities, permitted uses, and management activities should occur at levels that maintain or allow improvement of soil function, riparian vegetation, and water quality at the stream reach scale. This guideline would not apply to fine-scale activities and facilities such as intermittent livestock crossing locations, water gaps, or other infrastructure used to manage impacts to riparian areas at a larger scale. **GL:** Fire wood cutting or wood removal should be managed in remaining mesquite bosques to avoid impacts to understory species, tree density, tree growth, and to avoid channel downcutting and accelerated erosion.
Wildlife, Fish and Plants	**ST:** Direction for species listed as threatened, endangered, proposed, or candidate takes precedence over direction for species not listed by the U.S. Fish and Wildlife Service.

	ST: Timing restrictions will be applied to projects and activities that have the potential to negatively affect federally listed species, bald eagles, and golden eagles to minimize or avoid impacts to survival or successful reproduction. **GL:** Habitat management objectives and species protection measures from approved recovery plans should be applied to activities occurring within federally listed species habitat to promote recovery of the species. **GL:** To improve the status of species and prevent Federal listing, management activities should comply with species conservation agreements, assessments, strategies, or national guidelines. **GL:** Projects and management activities should be designed or managed to maintain or improve habitat for native species and to prevent or reduce the likelihood of introduction or spread of disease. **GL:** Project design should include measures to minimize the negative impact of pesticides, herbicides, or chemicals to species and their habitat. For example, chemical-free buffers could be placed around bat roosts, riparian or aquatic habitat. **GL:** Structural improvements should be planned and managed to provide wildlife with safe use of water, and to allow safe passage for wildlife prone to movement restrictions, such as pronghorn. For example, the bottom wire of fences should be smooth and at least 18 inches high to allow pronghorn passage. **GL:** Timing restrictions should be applied to projects and activities that potentially negatively affect Southwestern Region sensitive species and pronghorn. The intent is to minimize or avoid impacts to survival or successful reproduction. **GL:** Projects and management activities should be designed and implemented to maintain refugia and primary life cycle needs of Southwestern Region sensitive species and to protect and provide for narrowly endemic species and species with restricted distributions where they are likely to occur. **GL:** Established protocols should be followed to prevent the introduction and spread of disease, such as chytrid fungus (*Batrachochytrium dendrobatidis*) that kills amphibians. **GL:** New road and new trail locations should be designed to maintain species access to adjoining habitat, to maintain habitat for dispersal and migration, and to meet species' life history requirements, including fawning habitat for pronghorn.
Invasive Species	**GL:** Measures should be incorporated into authorized activities, project planning, and implementation to prevent, control, contain, and eradicate priority infestations or populations of invasive species to ensure the integrity of native species populations and their habitats is maintained. **GL:** Integrated pest management approaches and other treatments to control invasive species should be used to improve watershed condition and maintain ecosystem function while minimizing project impacts on native species.
Roads and Facilities	**GL:** Roads should be located, designed, and maintained to move toward or maintain desired conditions for other uses and resources. **GL:** Soil and water BMPs should be implemented to protect water quality while designing, constructing, reconstructing, or relocating new and existing roads, parking

	areas and pullouts. For example, permanent and temporary road construction and relocation should: • Occur outside of streamcourses and aquatic management zones, except where crossing is required. • Avoid wetlands, springs, seasonally wet meadows, and montane meadows. • Avoid soils that are unstable and highly erodible where connected to streamcourses. **GL:** Existing roads should be used or realigned before new roads are constructed to avoid areas where disturbance-sensitive threatened and endangered species are present. **GL**: For projects where long-term access is not needed, temporary roads should be used and naturalized in a timely manner. The intention is to have the road footprint, and potential impacts from road use, such as possible introduction of invasive species, modification of scenic integrity objectives, or increased sedimentation into connected waters, on the landscape for as short a time as possible. **GL:** Bridges, culverts, stream crossings on permanent roads, and diversion structures should be designed to allow safe passage for aquatic organisms. Passage barriers are acceptable when needed to physically separate native and non-native species.
Trails and Trailheads	**GL:** Trails and trailheads should be designed, built, rerouted, or maintained utilizing current best practices that promote sustainable trail surfaces, prevent conflicts with neighboring lands, address impacts to other resources, and consider user experiences. **GL:** Unplanned, user-created trails should be managed to prevent future access. Resources damaged by unplanned, user-created trails should be rehabilitated to accelerate recovery and to prevent further resource impacts.

Desired Condition

Desired conditions are well defined in the current Forest Plans for Apache-Sitgreaves, Coconino, and Tonto National Forests at different scales. These desired conditions are integrated and summarized below in relation to aquatic species, habitats, and the ecological components that influence them.

At the landscape scale, ecological conditions for habitat quality, distribution, and abundance should contribute to self-sustaining populations of native and desirable nonnative plants and animals that are healthy, well distributed, connected, and genetically diverse. Conditions should provide for the life history, distribution, and natural population fluctuations of the species within the capability of the landscape. Habitat configuration and availability allows populations to adjust their movements (e.g. seasonal migration, foraging) in response to climate change and promote genetic flow between populations. Habitat quality, distribution, and abundance should exist to support the recovery of federally listed species and the continued existence of all native and desirable nonnative species.

Water quality, stream channel stability, and aquatic habitats should retain their inherent resilience to natural and other disturbances. Instream flows provide for channel and floodplain maintenance, recharge of riparian aquifers, water quality, and minimal temperature fluctuations. Streams and their adjacent floodplain are capable of filtering, processing, and storing sediment; aiding floodplain development; improving floodwater retention; and increasing groundwater recharge. The water and sediment balance between streams and their watersheds allow a natural frequency of low and high flows. Stream condition

is sufficient to withstand floods without disrupting normal stream characteristics or uncharacteristically altering stream dimensions (e.g. bankfull width, depth, slope, and sinuosity). Riparian-wetland conditions maintain water-related processes (e.g. hydrologic, hydraulic, and geomorphic) as well as their physical and biological community characteristics, functions, and processes. Stream (lotic) riparian-wetland areas have vegetation, landform, and/or large coarse woody debris to dissipate stream energy associated with high waterflow.

Natural ecological disturbances (e.g. flooding, scouring) promote a diverse plant structure consisting of herbaceous, shrub, and tree species of all ages and size classes necessary for the recruitment of riparian-dependent species. Riparian obligate plant species within wet meadows, around springs and seeps, along streambanks, and active floodplains provide sufficient vegetative ground cover (herbaceous vegetation, litter, and woody riparian species) to protect and enrich soils, trap sediment, mitigate flood energy, stabilize streambanks, and provide for aquatic and riparian dependent species.

Streams and aquatic habitats should support aquatic species providing the quantity and quality of aquatic habitat within reference conditions. Aquatic species habitat conditions provide the resiliency and redundancy necessary to maintain species diversity and metapopulations. Streamflows provide connectivity among aquatic species populations and provide unobstructed routes critical for fulfilling needs of aquatic species. Floodplains and adjacent upland areas provide diverse habitat components (e.g. vegetation, debris, logs) as necessary for migration, hibernation, and brumation (extended inactivity) specific to the needs of riparian-obligate species (e.g. narrow-headed gartersnake).

The wildlife, fish, and rare plant program area's (Forest Service manual and handbook 2600) responsibility is to ensure that habitat is managed for all existing native and desired non-native wildlife, fish, and plant species in order to maintain viable populations, throughout their geographic range, with a focus on ecological integrity. Therefore, species and habitat planning and evaluation are integral to forest management and activities. In addition, habitat enhancement, inventory and monitoring, and habitat assessments are conducted. Conservation strategies, research or studies, and public education are additional important components of this program that are often conducted in collaboration with other resource areas and agencies. As stated above, Appendix A contains all relevant desired conditions from the Forest Plans related to the alternatives and aquatic species or habitats.

Management Area

The project area includes 16 management areas (MA) as described in the Apache-Sitgreaves, Coconino, and Tonto National Forest Plans, and they are incorporated by reference. Table 2 below displays the MAs located within the project area, forest plan MA emphasis, and the relationship between MA total acreage to the project.

For additional information, see the forest plans where detailed descriptions of forestwide resource direction specific to the management areas.

Table 2. Forest Plan Management Areas (MA), descriptions, and comparison of Forestwide to Project acres.

Forest Plan Management Areas within the Project Area	Description	Forestwide Acres	Acres within Project Area
General Forest	The emphasis of this area is to restore priority 6th level HUC, and provide forest products. A wide variety watersheds, restore fire-adapted ecosystems, reduce the threat from uncharacteristic wildfire of management activities occur and a	1, 224,071	417,565

Forest Plan Management Areas within the Project Area	Description	Forestwide Acres	Acres within Project Area
	wide variety of forest products are available within this management area. Lands identified as suitable for timber production have a regularly scheduled harvest of commercial timber.		
Community-Forest Intermix	Forest managers work toward achieving the goals outlined in the CWPPs for the counties within the Apache-Sitgreaves NFs. A higher degree of temporary ground disturbance may occur. The amount of snags and residual large coarse woody debris is generally lower than in the General Forest Management Area. In addition, forest openings are larger and basal areas are lower than in the General Forest Management Area. The management approach within this management area is to complete initial treatments to reduce fire hazard.	60,564	23,365
Wildlife Quiet Area	There is an emphasis on improving wildlife habitat and maintaining existing wildlife developments. Management of habitat within WQAs may provide a benchmark for assessing effects of activities on generally undisturbed wildlife populations. The road in the Open Draw WQA is managed as open on a seasonal basis.	50,173	22,401
Wild Horse Territory	The forests work….to keep grazing use in balance with available forage.	18,761	18,761
Natural Landscape	The management emphasis is to retain the natural appearing character of these areas. Management activities occur mostly for ecological restoration because of natural ecological events or previous management actions. Management activities may include restoration of ecological conditions or habitat components, soil stabilization, planned and unplanned ignitions, hazardous fuels reduction, and invasive species reduction. Livestock grazing may occur where appropriate.	404,802	13,191
High Use Developed Recreation Area	In addition to recreation use, other uses (including livestock grazing, timber management, and wildlife management) may occur in combination with surrounding recreation and scenic desired conditions.	16,549	8,096
Energy Corridor	Energy corridors are generally not managed to provide recreation opportunities. They are managed for very low scenic integrity where vegetation and structural changes may attract attention and dominate the landscape when viewed from nearby.	2,547	1,511
Long Valley	predominantly ponderosa pine, but also includes grasslands, riparian forest, pinyon juniper, mixed conifer, and wetlands, springs Designated wilderness, eligible WSR, IRAs, National Trails, proposed RNA	164,055	155,370

Forest Plan Management Areas within the Project Area	Description	Forestwide Acres	Acres within Project Area
Pine Belt	Ponderosa pine: but also includes 8 other ERUs within 4FRI boundary?, designated wilderness, no recommended wilderness, has eligible WSR, IRAs, Gus Pearson RNA, Red Mtn Geologic Area, Scenic Roads, National Trails, Riparian forest , streams, wetlands, springs	426,832	89,663
East Clear Creek	Ponderosa pine and mixed conifer with scatter pockets of riparian, grasslands, and wetlands, springs. Eligible WSR, designated Botanical Area and National Trails	45,711	45,711
Anderson Mesa	Dominated by pinyon juniper, grassland, and ponderosa pine vegetation, also mixed con with aspen and is an important pronghorn habitat area. No designated or proposed wilderness, has eligible WSR, IRAs, Scenic Roads, Riparian		23,370
Verde Valley	Vegetation is predominantly desert, grassland, chaparral, and pinyon juniper, some ponderosa pine, with riparian forests along stream channels. Perennial waters include portions of the Verde River, Oak Creek, Wet Beaver Creek, West Clear Creek, and Fossil Creek. Streams, wetlands, springs. Has designated and proposed wilderness, designated WSR, eligible WSR, proposed West Clear Creek RNA, 3 botanical areas, 1 geologic area, IRAs, National Trails, Riparian	323,455	1,052
Mogollon Rim-(4D)	Manage for a variety of renewable resource outputs with primary emphasis on intensive, sustained yield timber management, timber resource protection, creation of wildlife habitat diversity, increased populations of emphasis harvest species, and recreation opportunity.	129,784	128,875
Mogollon Rim- Sierra Ancha (5D)	Manage for a variety of renewable resource outputs with primary emphasis on intensive, sustained yield timber management, timber resource protection, creation of wildlife habitat diversity, increased populations of emphasis harvest species, and recreation opportunity.	139,494	111,272
General Management Area (1F, 2F, 3I, 4F, 5G, 6J)	5G, 1F, 2F, 4F, 3I, 6J: Manage for a variety of renewable natural resources with primary emphasis on wildlife habitat improvement, livestock forage production, and dispersed recreation. Watersheds will be managed so as to improve them to a satisfactory or better condition. Improve and manage the included riparian areas (as defined by FSM 2526) to benefit riparian dependent resources.		29,310
Forest-wide	Wildlife and fish habitat elements will be recognized in all resource planning and management activities to assure coordination that provides for species diversity and greater wildlife and fish populations through improvement of habitat. Ensure that fish and wildlife habitats are managed to maintain viable populations of existing native vertebrate species. Improve habitat for selected species. Cooperate with appropriate State Fish and Wildlife agencies. Prevent destruction or adverse modification of critical habitats for Threatened and Endangered species and manage for a goal of		

Forest Plan Management Areas within the Project Area	Description	Forestwide Acres	Acres within Project Area
	increasing population levels that will remove them from the lists.		

*Acres and percentages are approximate as many mapping inconsistencies were found when we compared the management area boundary maps to vegetation stand data. Forest plan MA mapping was conducted at a very coarse scale whereas the numbers associated with our vegetation stand data is much more precise.

Federal Law

Endangered Species Act (as Amended)

The Endangered Species Act of 1973 requires Federal agencies to conserve threatened and endangered species and the ecosystems on which they depend: Section 7(a) (1) outlines the procedures for Federal interagency cooperation designed to conserve federally listed species and their designated critical habitats. Section 7(a) (2) outlines the consultation process and the requirement that any action authorized, funded, or carried out by a Federal agency would not likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat.

Clean Water Act

The Clean Water Act (CWA, 33 USC 1251 et seq.) established structure for regulating quality standards for surface waters and requires states to set standards to protect water quality, including regulation of stormwater and wastewater discharges during construction and operation of a facility.

Forest Service Manual (FSM) direction

The biological assessment and evaluation (BAE) was prepared in accordance with FSM direction 2672.42 and meets legal requirements set forth under Section 7 of the Endangered Species Act of 1973, as amended, and implementing regulations [19 U.S.C. 1536 (c), 50 CFR 402.12 (f) and 402.14 (c)] to ensure that Forest Service actions do not contribute to loss of viability of any native or desired non-native plant or animal species, or contribute to trends toward Federal listing of any species; and, to provide a process and standard by which to ensure that threatened, endangered, proposed, and sensitive species receive full consideration in the decision making process.

National Forest Management Act

The National Forest Management Act of 1976, required the Secretary of Agriculture to develop guidelines for land management planning with the individual forest being the planning unit or area. The Act states that “Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area.” (36 C.F.R. § 219.19). A viable population is defined as “[a population] which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area.” (§ 219.19). Therefore, management of viable populations is intended to be accomplished at the individual National Forest level (planning area). As part of NFMA, projects must also demonstrate compliance with applicable Forest Plan desired conditions, standards, and guidelines, or have completed a plan amendments as part of the decision.

National Environmental Policy Act

NEPA established procedures for decision making, disclosure of effects, and public involvement on all major federal actions. Forest Service Manual 1950.2 requires a consideration of the impacts of Forest Service proposed actions on the physical, biological, social, and economic aspects of the human environment (40 CFR § 1508.14).

Regional Forester Sensitive Species

Sensitive species are defined as "those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: a) significant current or predicted downward trends in population numbers or density, or b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5(19)). A primary objective of Forest Service policy is to develop and implement management practices to ensure that species do not become threatened or endangered due to Forest Service actions (FSM 2670.22). Key policies regarding sensitive species are to 1) assist states in achieving their goals for conservation of endemic species, 2) as part of the National Environmental Policy Act process, review programs and activities, through a biological evaluation, to determine their potential effect on sensitive species, 3) avoid or minimize impacts to species whose viability has been identified as a concern, 4) if impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole, but the decision must not result in loss of species viability or create significant trends toward federal listing, and 5) establish management objectives in cooperation with the state when projects on National Forest system lands may have a significant effect on sensitive species population numbers or distributions. Establish objectives for federal candidate species, in cooperation with the U.S. Fish and Wildlife Service and Arizona State (FSM 2670.32).

Forest Service Manual 2600 and Forest Service Handbook 2600

These directives provide direction, regulation, and policy regarding fish and wildlife management.

Executive Orders

Invasive Species, EO 13112 of February 3, 1999

This order requires Federal agencies to take actions to prevent the introduction and spread of invasive species; to provide for invasive-species control; and to minimize the economic, ecological, and human health impacts of invasive species.

Environmental Justice, EO 12898 of February 11, 1994

Federal Permits, Licenses, or Other Entitlements

The Clean Water Act applies to “waters of the United States” which include, but are not limited to: traditional navigable waters; interstate waters; wetlands adjacent to either traditional navigable waters or interstate waters, or that directly but relatively permanent water; non-navigable tributaries to traditional navigable waters that are relatively permanent, meaning they contain water at least seasonally. Wetlands and all other jurisdictional waters, including headwater streams, are recognized as important features in the landscape that provide numerous beneficial services for people, fish, and wildlife. Any project that

may result in the excavation or addition of fill materials to a watercourse (River, wash, arroyo, wetlands, etc.) requires a Section 404 Permit (Clean Water Act) from the US Army Corps of Engineers, and a State Water Quality Certification (Section 401) permit from the Arizona Department of Environmental Quality. This includes activities such as the installation of road crossings, bridges, and bank protection.

CWA Section 401 – Water Quality Standards. A Section 401 permit is required for "Any applicant for a Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates."

The major federal licenses and permits subject to Section 401 are Section 402 permits (point source discharges of pollutants other than dredged or fill material waters).

CWA Section 404 – Dredge and Fill Regulations – A Section 404 permit is required for point source discharges of dredged or fill material for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Exemptions exist for certain farming and forestry activities. When a Section 404 permit is required, a CWA Section 401 certification must first be obtained from the authorizing jurisdiction.

Topics and Issues Addressed in This Analysis

Purpose and Need

Aquatic habitat and species are directly related to the purpose and need. The purpose of this project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity in ponderosa pine ecosystems to conditions within the natural range of variation. The outcome of improving structure and function is increased ecosystem resiliency. There is also a need to reduce the risk of undesirable fire behavior and effects and restore frequent low or mixed severity fire regimes that maintain these ecosystems. There is also a need to improve the condition and function of riparian areas, wet meadows, streams, and springs in the Rim Country project area in order to sustain these features for terrestrial and aquatic habitat, as well as recognizing the ecological and socio-political importance of these areas. There is a need to have adequate access for project implementation, but then decommission temporary roads after use to restore these areas once project activities are completed. In addition, there is a need to decommission unneeded routes identified during the forest Travel Management Rule review processes as part of the restoration of the landscape in the project area. Reducing road density and improving road and stream crossings would maintain natural flow regimes, provide connectivity for aquatic species and habitats, and reduce sediment delivery to streams and other water bodies. Portions of the purpose and need directly related to aquatic habitat and species is listed below:

- Reduce road density and road/stream crossings to maintain natural flow regimes, provide for aquatic organism passage and reduce sedimentation.
- Restore stream channels to increase channel structure and complexity as well as thermal refugia for aquatic species.
- Maintain or restore wet meadows and wetlands which provide stream base flows and reduce stream temperatures.
- Provide for vegetative ground cover and soil stability to reduce erosion.
- Restore native riparian vegetation to provide stream shading, bank stability, and lower water temperatures.

- Improve watershed conditions by reducing fuel loadings, restoring the natural fire regime and improving road crossings.

Issues

No issues identified through the scoping process are related to aquatic species or habitat.

Other Resource Concerns

Trout Unlimited and AZGFD have brought forth the concern for resilience of cold water streams to climate change in regards to water temperatures. These concerns are also part of desired conditions for the Forest Plans and are addressed by the purpose and need.

Methods

This report describes the current condition and analyzes the environmental consequences of the alternatives to a total of 28 endangered, threatened, proposed, candidate, and sensitive aquatic species and their habitats. The species analyzed include twelve fish species, two mollusks, two gartersnakes, and twelve invertebrates. For analysis and discussion purposes, some of the species were grouped together, where appropriate, as this facilitates the comparison of changes between alternatives. Analyses compared and summarized the resource indicators and measures identified above. For invertebrate species, more qualitative analyses were required, primarily due to the unknown distributions of most of these species, limited distribution of these species, or the limited impacts to these species associated with the proposed actions. Analyses included the changes (i.e., increase, decrease, or change from current conditions) for the indicators or measures, and how they can impact aquatic species and their habitats.

For the purposes of analysis, mechanical vegetation treatments were analyzed across vegetation type (Ecological Restoration Unit) within the project area. Intuitively, mechanical vegetation treatments in forested Ecological Restoration units (ERUs) will be more extensive to move towards desired conditions than treatments in savannas, grasslands, meadows, and riparian areas to reduce encroachment. Prescribed burning was similarly analyzed across the project area regardless of vegetation type (ERUs).

The Transportation system (roads) needed to implement Rim Country were analyzed quantitatively and qualitatively. Quantitative analysis was completed based on existing Forest Service roads (existing condition) and the number of ML-1 roads opened (action alternatives). While the analysis assumes all ML-1 roads will be opened for use, intuitively not all the roads will be opened or used at the same time across the project area. Therefore, the analysis is over estimating the potential impacts of the action alternatives. The miles of roads (ML-1 thru 5) to be used is the same for both action alternatives as was therefore analyzed only once. Road relocation, decommissioning, and temporary roads were analyzed qualitatively for the action alternatives as the location of these activities is unknown. Miles proposed for each were based on averages across the three Forests over a given time period. Therefore, a more accurate analysis by species was not feasible. Miles of proposed road relocation and decommissioning were the same for both action alternatives and therefore only analyzed once. Mileage of temporary roads differed between the action alternatives and was analyzed as part of those alternatives.

In Woods Processing, rock pits, and aquatic/watershed restoration do not differ in acreage or mileage between the action alternatives. For those reasons, these three portions of the action alternatives were analyzed only once as ‘Actions Common to Alternatives’. In Woods Processing Sites was analyzed quantitatively for the Coconino and Tonto NFs where exact locations and acreages of proposed sites were available. A qualitative analysis was completed for the Apache-Sitgreaves because they are not proposing the use of identified processing sites, only in woods drying of biomass as needed. The acres of rock pit

use and expansion was analyzed quantitatively, as were miles of general and heavy mechanical stream restoration.

Information Sources

The basis of these effects analyses are the observations and professional judgement of the project fisheries biologist as well as the best available science. Species and habitat distribution data were created specifically for this project based on existing GIS datasets, survey reports, Federal Register listings, 5-Year Reviews, and local knowledge. Species occupied and potential habitat mapping was reviewed collaboratively by state and federal biologists in an effort to be as accurate as possible. The data are based primarily on information obtained from existing literature and inventory or monitoring conducted by the Arizona Game and Fish Department, U.S. Fish and Wildlife Service, Forest Service, and other agencies and cooperators.

Incomplete and Unavailable Information

The precise distribution of the aquatic organisms or the quality of their habitat is not well known throughout the entire analysis area. Therefore, species occurrence was extrapolated from existing survey information then reviewed by Arizona Game and Fish Department Fisheries Managers and Forest biologists to incorporate local knowledge. Similarly, recent stream habitat survey information were not available to determine the current habitat conditions for most streams within the project area.

Aquatic macroinvertebrate species (i.e., sensitive species) have had very few surveys across the project area, and known occurrences are very limited. Information was used from recent Forest level analyses such as Forest Plan Revision or Travel Management Planning in an effort to incorporate the most recent species or habitat distribution. For analyses proposed, these species were assumed to occur throughout the stream(s) where they have been documented.

Because of these imprecisions, the analysis will rely heavily on Watershed Condition Framework to define existing conditions and the implementation of the Design Features, Best Management Practices, Conservation Measures, and guidance in the Aquatic and Watershed Flexible Toolbox Approach (AWFTA) to support conclusions and lay the framework for implementation.

Spatial and Temporal Context for Effects Analysis

The spatial analysis area includes the entire Rim Country Project Area and adjacent areas that could be impacted from activities occurring downstream of the proposed project area, or adjacent lands. The analysis area will vary by the species present within and downstream of Rim Country subwatersheds, and the extent and location of proposed activities within the various alternatives. For GIS quantitative analyses, areas for most of the aquatic species were developed to include all potential impacts. Species analysis area boundaries were determined by including all of the subwatersheds within the project area that drain into occupied or suitable habitat, designated or proposed critical habitat, and identified recovery habitat. Additional spatial boundaries within each species analysis areas were defined specifically to delineate direct and indirect impacts; these are described below.

Miles of stream identified for general and heavy mechanical stream restoration were identified spatially using factors that promote successful treatments and project design features. Potential locations for general stream treatments were identified based on stream gradient. Stream gradient was mapped using LiDAR data and averaging within reaches. Reaches with low (0-2%) and moderate (2-4%) stream gradient were used for general stream treatment identification based on Rosgen stream types and gradients where stream restoration is the most successful. Heavy mechanical stream reaches are a subset of the identified general stream restoration reaches that were then filtered by the ability of machinery to

access locations and design features (slope restriction). These were identified by removing reaches with canyon slopes >25% and further than 0.25 miles from roads.

Direct/Indirect Effects Boundaries

Direct impacts to species were assessed for only those actions that occur within species habitat and have an immediate impact to species or habitat; within streams for fish and mollusks and within streams or riparian areas for gartersnakes and aquatic macroinvertebrates. Indirect effects to riparian and aquatic habitat were assessed using riparian condition. Riparian areas and their condition directly influence aquatic habitats. Therefore, changes to riparian condition can impact aquatic habitat quality and quantity in a positive, negative or neutral manner.

A 250 ft. buffer on fish species habitat was used for analyzing acreage of direct impacts to habitat, as this includes the stream and the adjacent riparian and upland areas that directly influence aquatic habitat and species. For indirect impacts, all the analysis area (subwatersheds) that drains into the fish species habitat was included, as this captures all the potential indirect impacts that could occur from any upstream area or activity. Percentage of areas impacted by direct or indirect effects were calculated using the species analysis areas and the acres or miles proposed within those.

For the two gartersnake species a 600 ft. stream buffer was used for analyzing acreage of direct impacts to both species and habitat as this encompasses the width of the stream, the width of proposed critical habitat, and the extent of habitat used by the species. For indirect impacts, all the analysis area that drains into gartersnake habitat was included, similar to fish species. Percentage of areas impacted by direct or indirect effects were calculated using the species analysis areas and the acres or miles proposed within those.

The temporal boundaries for analyzing direct and indirect effects to aquatic species will be 10-15 years given habitat conditions and species occupancy can change over that timeframe. Direct effects to species are fairly immediate (e.g. harm or harassment), while indirect effects occur over a longer period as a result. Short term effects to habitat or species occur over a timeframe of one year to include a monsoon season and spring flow event. This is based on the assumption that monsoonal rain events (by their nature) increase erosion and sedimentation to aquatic habitats, while spring runoff tends to mobilize sediment downstream. Mid-term effects occur over a timeframe of 1-2 years to factor in at least one entire growing season for vegetation, such as within a single timber pay unit or prescribed burn. Long-term effects to habitat can last for 2-15 years or seasons to address entire sale areas within multiple subwatersheds.

Cumulative Effects Boundaries

The spatial boundaries for cumulative effects are the combined areas of direct and indirect impacts as described above. Additionally, for some species and some activities it can include private lands within the Forests and lands adjacent to, or upstream and downstream of the project area. Temporal boundaries went back 30 years in time to include any activity with geospatial data on for quantitative analysis. Past management activities that did not have geospatial data were described by general resource area along with potential last effects going back further in time.

Assumptions

- Species occurrence geospatial layers utilized for analysis contain up-to-date information as of September 2018 and represent species current occurrence as well as potential suitable habitat.

- Species analysis areas represent the drainage network where direct and indirect impacts could occur to species or habitat.
- Watershed Condition Framework assessments utilized for existing condition accurately reflect resource indicators for aquatic species and habitats.
- Analyzing mechanical vegetation and prescribed burning treatments across vegetation types will address the highest level of impacts that may occur; therefore, impacts less than that are inherently addressed.
- Project implementation will include all applicable Design Features, Best Management Practices, and Conservation Measures which are expected to minimize impacts throughout the analysis.
- The Aquatic and Watershed Flexible Toolbox Approach is adaptive management and guidance within the document will be implemented, including circumstances on where treatments are applicable, which inherently minimize impacts to aquatic species and habitats.
- Projects lists and acreages provided for Cumulative Effects analysis accurately represent past, current, and future activities within the project area.

Resource Indicators and Measures

Resource measures were identified for those components that could be spatially defined and carried through the analysis of alternatives. Quantitative analyses were conducting for the following resource measures: 1) acres of mechanical thinning, 2) acres of prescribed burning, 3) miles of open ML-1, 4) acres of In Woods Processing Sites, 5) acres of rock pits use and expansion, 6) miles of general stream restoration, and 7) miles of heavy mechanical stream restoration. For some species (e.g., sensitive aquatic macroinvertebrates) quantitative evaluation is not possible, so the analyses will be more limited and/or qualitative for some species. Qualitative analyses were used for components that could not be spatially defined such as temporary roads, road relocation, and road decommissioning which are part of both action alternatives. Resource indicators will allow for the comparison between the existing condition and each alternative, and how they may directly or indirectly impact aquatic species and their habitats. Resource elements are larger in context and represented by the resource indicators for analysis. For example, riparian condition represents both aquatic habitat quality and quantity. Measures represent the amount effect to the resource indicators; therefore if acres or miles of measures increase then potential effects to resource indicators may increase. Impacts to indicators will be addressed on the temporal context described previously as well as by direct and indirect impacts. Additional information is provided later for each group of species (i.e., fish, frogs, snakes, and invertebrates) analyzed within the effects sections. The resource indicators, elements, and measures are listed in Table 3 below.

Several of the aquatic invertebrate sensitive species were not quantitatively analyzed using the resource indicators and measures. This was not possible primarily due to the species limited or unknown distributions, or no or limited impacts that could result from the proposed actions. GIS maps were reviewed for both alternatives to qualitatively assess the impacts that could occur to these species from the proposed actions (i.e., mechanical vegetation treatments and prescribed burning).

Table 3. Resource indicators and measures for assessing effects between alternatives.

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?	Source (LMP S/G; law or policy, BMPs, etc.)?
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition -Short and Mid-term effects negative - Long Term effect neutral or positive 2. Modification of Gartersnake Behavior - Short and Mid-term effects negative - Long Term effect neutral or positive 3. Harm of Gartersnakes - Short term effects negative - Mid and Long Term Effects Neutral 4. Pollutants, Exotic Species and/or Disease - Short, Mid-, and Long Term effects negative	Acres of mechanical thinning treatments	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral or positive 2. Modification of Gartersnake Behavior - Short and Mid-Term effects negative - Long Term effect neutral or positive 3. Harm of Gartersnakes - Short term effects negative - Mid and Long Term Effects Neutral 4. Pollutants, Exotic Species and/or Disease - Short, Mid-, and Long Term effects negative	Acres of Prescribed Burning	Yes	LMP S/G, BMPs

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?	Source (LMP S/G; law or policy, BMPs, etc.)?
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-Term effects negative - Long Term effect neutral or positive 2. Habitat Connectivity - Short and Mid-Term effects negative - Long Term effect neutral or positive 4. Pollutants, Invasive Species - Short, Mid-, and Long Term effects negative	Miles of Open ML-1 and Temporary Roads (Road Density and Location)	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral	Acres of In Woods Processing Sites (IWPS)	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral	Acres of Rock Pits	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short Term effect negative - Mid and Long Term effects neutral or positive	Miles of general stream restoration	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral or positive 2. Instream Aquatic Habitat - Short effects negative - Mid and Long Term effects positive 3. Harm of Fish or Gartersnakes - Short effects negative - Mid and Long Term effect neutral or positive 4. Pollutants, Invasive Species - Short, Mid-, and Long Term effects negative	Miles of heavy mechanical stream restoration	Yes	LMP S/G, BMPs

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?	Source (LMP S/G; law or policy, BMPs, etc.)?
Habitat Quality and Quantity for Invertebrates	1. Riparian Condition - Short or Mid-Term effects negative - Long Term effects neutral or positive	Qualitative change in sediment delivery or habitat impacts.	Yes	LMP S/G, BMPs

Riparian Condition

Riparian Condition is being used as a surrogate to indicate potential changes in multiple factors that directly influence aquatic and riparian habitat quality and quantity such as sediment load, streamside canopy cover and structure, large woody debris, stream temperature, and changes in peak flows. The current condition of riparian areas indicates their ability and resiliency to provide the ecosystem services listed above in regards to potential direct and indirect impacts. Therefore, riparian areas in good condition would ameliorate potential short term direct impacts to riparian and aquatic habitat whereas areas in poor condition potentially would not. Additionally, resource measures could lead to positive or negative impacts to riparian condition (and thus aquatic or riparian habitat) depending on the timeframe.

Effects on riparian condition will be assessed quantitatively by alternative by comparing predicted direct, indirect, and cumulative effects by major proposed activities within the project area.

Habitat quality and quantity analysis topics include:

- Changes in streamside vegetation cover and structure.
- Changes in sediment delivery to streams altering aquatic habitat and food base.
- Changes in recruitment of large woody debris from riparian areas to streams altering aquatic habitat.
- Changes to stream temperatures as a result of warm water runoff from upland sources or reduced streamside canopy cover.
- Changes to aquatic habitat as a consequence of increased flows caused by removal of upland vegetation resulting in increased storm water runoff.

Riparian and wetland areas are the interface between terrestrial and aquatic ecosystems and are an integral part of the watersheds in which they occur. Consequently, the health of these areas is closely interrelated to the condition of the surrounding watershed (Debano and Schmidt 1989, Hornbeck and Kochenderfer 2000). The health of riparian corridors is dependent on the storage and movement of sediment through the channel system but also the movement of sediment and water from surrounding hillslopes into the channel system. These processes can be altered by human induced and natural disturbances either indirectly to the watershed or directly to riparian areas themselves. Riparian areas provide localized microclimate, stream shading, bank stability, and inputs of large wood and organic matter to streams. They are critical for maintenance of water quality and quantity, contribute to sediment retention and stream bank building and maintenance, and influence in-channel geomorphic processes.

Streamside canopy cover and structure are important to riparian and aquatic habitat by providing riparian habitat for gartersnakes, stream shading, bank stability, and nutrients in the form of organic matter. Removal of trees and shrubs can reduce vegetation structure, canopy cover and stream shading. This can potentially lead to increased stream temperatures, reduced bank stability, and reduced organic matter (allochthonous material) reaching the stream. It can also lead to reduce habitat quality and quantity for riparian obligate species that are dependent upon streamside canopy and structure as part of their life history.

While streams can process normal sediment levels, elevated levels can cause negative impacts. Most streams carry or move sediment and the amount varies seasonally. Sediment transport involves detachment and entrainment of particles, their transport, and their deposition. When additional fine sediments are transported, they can accumulate in relatively clean or porous substrate such as gravels and habitats such as pools. Increased levels of sedimentation can have adverse effects on aquatic species, habitats, and riparian ecosystems. Fine sediment deposited in spawning gravels can reduce egg survival (Hicks et al., 1991) by reducing the availability of dissolved oxygen in the gravel. Primary production, benthic macroinvertebrate abundance, and thus food availability for fish and gartersnakes (prey) may be reduced as sediment levels increase. Large wood in streams is an important roughness element influencing channel morphology, sediment distribution, and water routing. Common sources of large wood include falling of dead trees, wind-throw and breakage, and landslides. Large wood influences channel gradient by creating step pools and dissipating energy, lengthens streams by increasing sinuosity, and serves as an important agent in pool formation. In low order streams, in particular, large wood collects sediment and larger substrates during high flows events and can account for a large proportion of sediment/substrate storage sites. It is also instrumental in nutrient retention.

Stream temperatures can affect the survival and production of fish throughout all life stages. Warm water temperatures can reduce survival of eggs as well as hatching success. For juveniles, growth can decline above certain temperatures, which differs by species, and is accompanied by decreased feeding, increased stress, and increased warm water diseases or parasites. Finally, at a certain point, temperatures become lethal for all fish.

Alteration of flows can have major physical effects on aquatic ecosystems. Increases in peak flows or frequency can increase bed scour or accelerate bank erosion negatively impacting aquatic habitat. Small streams are the more easily altered as they are intimately associated with their riparian zones and are highly responsive to alterations in riparian vegetation and the surrounding watershed. These streams carry water, sediment, nutrients, and large wood from upper portions of the watershed which influence the quality of aquatic habitat downstream.

Potential effects of Mechanical Vegetation Management

Chamberlin et al. (1991) reviewed literature on timber harvest, silviculture and watershed processes, which are relative to potential impacts to riparian condition. Mechanical vegetation treatments can increase erosion, sedimentation, and alter peak streamflows via removal of vegetation and ground disturbance. Forest harvest activities can influence both upland erosional processes and the way that streams process sediment in their channels. The potential for surface erosion is related to the amount of bare compacted soil exposed to rainfall and runoff. If soil infiltration is sufficiently reduced, water runs off rather than through soil resulting in higher peaks flows and increased sediment transport. Therefore, features such as landings and skid trails can contribute large quantities of fine sediment and runoff to stream channels. Patterns of yarding and skidding can alter drainage paths and redirect water onto areas more likely to erode than natural channels. In addition to influencing soil structure, mechanical harvest

can influence snow accumulation and melt rates as well as evapotranspiration and soil water which can also alter peak flows.

Potential effects of Prescribed Fire on Riparian Condition

Response of riparian condition and aquatic ecosystems to fire can be highly variable and dependant on fire attributes (e.g. severity, intensity, fire size), magnitude of subsequent storms and snowmelt events, amount of the watershed burned, stream size, and topography (Kerschner 2004; Gresswell 1999). Indirect fire impacts can consist of altered peak flows and hydrologic processes (Minshall and Brock 1991), hillslope erosion and stream sedimentation (Swanson 1981; Megahan 1991; Rinne 1996) (Bisson et al. 2003), disrupted nutrient cycling (Swanson 1981; Megahan 1991; Bozek and Young 1994), loss of streambank vegetation leading to increased stream temperatures (Minshall and Brock 1991), decreased large woody debris, and fragmented aquatic habitat dynamics (Minshall and Brock 1991; Rieman and Clayton 1997; Swanson 1981; Megahan 1991; Bozek and Young 1994). Adverse changes in these attributes can negatively impact riparian condition, as well as aquatic habitat quality and quantity.

Fire related erosion and sedimentation can occur chronically (fine sediment delivery over long periods) or episodically (post-fire ash or sediment pulses, landslides and debris flows). Levels above what a riparian areas and stream can process, based on condition, can lead to negative effects to aquatic habitat quality and quantity. Large increases in sediment can lower pool density, reduce intragravel dissolved oxygen and circulation leading to loss of fish eggs, cover food sources for benthic macroinvertebrates, and reduce the efficiency of filter feeding macroinvertebrates.

Treatments in riparian areas change the vegetative structure, canopy cover, and reduce fuel continuity. This can potentially lead to increased stream temperatures, reduced bank stability, and reduced organic matter (allochthonous material) reaching the stream (Dwire et al. 2016). Reduced fuel continuity provides for resiliency of riparian areas during wildfires by potentially reducing fire intensity and severity. In general, effects of spring or fall prescribed burning on both upland and riparian species composition appear to be either negligible or similar in effects of low-severity wildfire and are generally neutral or beneficial (Dwire et al. 2016). There are indications that the effects of prescribed fires are much smaller and shorter-lived to the effects of wildfire.

Fire also plays an important role in maintaining heterogeneity (riparian condition) in both terrestrial and aquatic habitats (Gresswell 1999). Periodic variations in the influx of sediment and coarse woody debris from riparian areas to the active stream channel contribute to aquatic habitat heterogeneity by creating complex stream morphology and can be reflected in a diverse fish community (Reeves et al. 1995; Rieman and Clayton 1997; Gresswell 1999; Rieman et al. 2003; Robinson et al. 2005).

Fire regimes in riparian areas relative to adjacent uplands vary. In drier areas, similar to the project area, historical fire frequencies in uplands and riparian areas are often comparable (Dwire et al. 2016). Dry ponderosa pine/Douglas-fir forest of central Idaho had similar fire return intervals for upland and riparian stands. Where the vegetation composition of riparian areas is similar to adjacent uplands, streamside areas are likely to burn as frequently as the surrounding uplands. Therefore, the suppression of fires for decades has likely altered riparian areas and made them more susceptible to uncharacteristic wildfire similar to uplands.

Potential effects of Roads on Riparian Condition

Water runoff and sediment yield are key physical processes whereby roads have an impact on streams and other aquatic systems, and the distance of these effects can vary widely. Roads on upper hillslopes concentrate water flow, which can form channels higher on slopes. This process leads to smaller, more

elongated first-order drainages and longer total length of the channel network. Water rapidly runs off relatively impervious road surfaces, especially in storm and snowmelt events, increasing runoff. Increased runoff associated with roads may increase the rates and extent of erosion, reduce percolation and aquifer recharge rates, alter channel morphology, and increase peak flows. Increased peak flows can degrade aquatic ecosystems by altering riparian conditions, channel morphology, or aquatic habitat. Surface erosion from forest roads affects the fine sediment budget and may impose a chronic condition of sediment inputs to streams affecting the stream substrate and the health of aquatic life (Luce et al. 2001). Chronic erosion from roads can greatly reduce an aquatic systems integrity, and in some cases can be the primary source of sediment input (Switalski et al. 2004). Sediment concerns are generally highest when roads are not sufficiently drained; with sufficient drainage, water and sediment from upland segments of roads can be diverted, filtered through forest vegetation, and not routed to streams. As such, upland segments of roads can generally be designed to mitigate sediment delivery concerns.

Road density in a watershed affects the collection and transport of water out of the watershed (Burroughs and King 1989). The potential for increases in runoff rates increases with more miles of road. Road closures would be beneficial to water quality if the roads were properly decommissioned and well maintained after closure. A well-maintained, closed road system would result in less sediment from road surface erosion. Roads not proposed for use in the project area may have long-term adverse effects on water quality if they are not properly maintained. For this analysis, it is assumed that when a road is closed it will continue to have impacts on the aquatic system, and both of the action alternatives involve the closure of ML 1 roads and temp roads to use by the public rather than the physical removal of roads.

The primary concern is erosion and sediment delivery from roads that are near streams and that cross streams. Fine sediment is a key physical element to focus on when attempting to delineate land management impacts on aquatic habitat and biota (Rinne 1990). Excessive fine sediment input into a stream can fill pool habitat and reduce both summer and winter rearing habitat for juvenile fish (Heede and Rinne 1990). Stream crossings reduce riparian vegetation and widening of the channel which can also impact water temperature (Poole and Berman 2001, Beschta 1997, and Heede 1980). Not all species and ecosystems are equally affected by roads, but overall the presence of roads is highly correlated with changes in species composition, population sizes, and hydrologic and geomorphic processes that shape aquatic and riparian systems (Trombulak and Frissell 2000).

Impacts to individuals

Impacts to individuals are considered direct impacts and can include mortality and modification of behavior. Mortality would only occur from actions within species habitats. Modification of behavior can include factors such as disruption of social and feeding behavior that could reduce potential breeding or the health of individuals. It also includes displacement from an area temporarily which can also impact breeding or health. Therefore, increased acres or miles of treatments within the direct effects analysis area equates to an increase in potential impacts to individuals.

Habitat Connectivity

This was selected as a resource indicator specifically for roads as they can fragment aquatic or riparian habitat and impede or reduce movement. Therefore, increased miles of open roads equates to decreased habitat connectivity.

Road density has been considered a useful index of several ecological effects of roads in a landscape. Effects are evident for faunal movement, population fragmentation, human access, hydrology, aquatic ecosystems, and fire patterns. Hydrologic effects, such as altered groundwater conditions and altered drainage upslope, are sensitive to road densities. Increased peak flows in streams and macroinvertebrate diversity may be impacted with increasing road densities. Road density is an overall index that averages

patterns over an area; its effects probably are sensitive to road type and width, traffic density, and network connectivity.

Pollutants and Invasive Species

This was selected as resource indicator for habitat quality to address the potential for introduction into aquatic habitats. Pollutants and disease introduced into aquatic habitats reduces habitat quality. Use of mechanical equipment and storage of fuels in or around streams or other water bodies can also introduce contaminants. Equipment that is not cleaned or leaking can bring oils or fuel directly into water.

Most chemical transport from roads occurs in storm water runoff through or over soil (Trombulak and Frissell 2000). Runoff pollutants alter soil chemistry, may be absorbed by plants, can affect stream ecosystems, where they are dispersed and diluted over considerable distances. Typical water-quality responses to road runoff include altered levels of heavy metals, salinity, turbidity, and dissolved oxygen. These water quality changes can be sporadic and localized due to fluctuations in water quantity.

Similarly, roads promote the dispersal of exotic or invasive species by altering habitats, stressing native species, and providing movement corridors that further spread these species. Mechanical equipment can carry exotic species or aquatic invasive species from one water body to another. This can spread species such as Didymo *(Didymosphenia geminata)* and Eurasian milfoil which can reduce aquatic habitat quality.

Affected Environment

Watershed Condition

The proposed project occurs within portions of 142 different 6th HUC subwatersheds. Of these watersheds, thirty-eight have less than 5% of their total area within the project boundary. Overall, the project area is dominated by functional-at-risk subwatersheds (about 451,500 acres, or 46 percent of the analysis area); with several impaired subwatersheds (about 316,800 acres, or about 32 percent of the analysis area) and a few properly functioning subwatersheds (about 220,400 acres, or about 22 percent of the analysis area). Thirty-six of the project area subwatersheds are part of species analysis areas throughout this document.

Watershed Condition Framework (WCF) rankings were used to described the existing conditions for aquatic species analysis areas at this scale. Five indicators most relevant to water quality and aquatic species are discussed in more detail: aquatic habitat, aquatic biota, riparian/wetland vegetation, water quality, and roads and trails (Figure 1). A more comprehensive analysis of all Watershed Condition Framework scores for the Rim Country Project Area can be found in the Watershed Cumulative Effects Specialist Report (MacDonald 2018).

For aquatic habitat, 8 subwatersheds were rated in good condition, 16 in fair condition and 12 watersheds rated in poor condition based on habitat quality, fragmentation, and stream channel condition (Figure 1). Watersheds in ‘poor condition’ for aquatic habitat largely reflect past land uses (i.e. grazing, logging), including fragmentation by roads, lack of large wood in channels, and altered channel morphology. Many of these conditions continue to persist long after the original impact.

For aquatic biota, 3 subwatersheds were rated in good condition, 16 in fair condition, and 17 watersheds were rated in poor condition based on community structure (natives vs. nonnatives/invasives) and continuity of populations.

For the riparian vegetation indicator, 6 subwatersheds were rated in good condition, 16 rated in fair condition, and 14 rated in poor condition based on relative condition and departure from potential. As with aquatic habitat, riparian conditions also reflect past land uses that are no longer active or allowed as well as current impacts (i.e. recreation, OHV).

For water quality, 26 subwatersheds were rated in good condition, 6 fair condition, and 4 rated in poor condition. This attribute rating is based on 303(d) status (percent of miles listed) and other known water quality impairments.

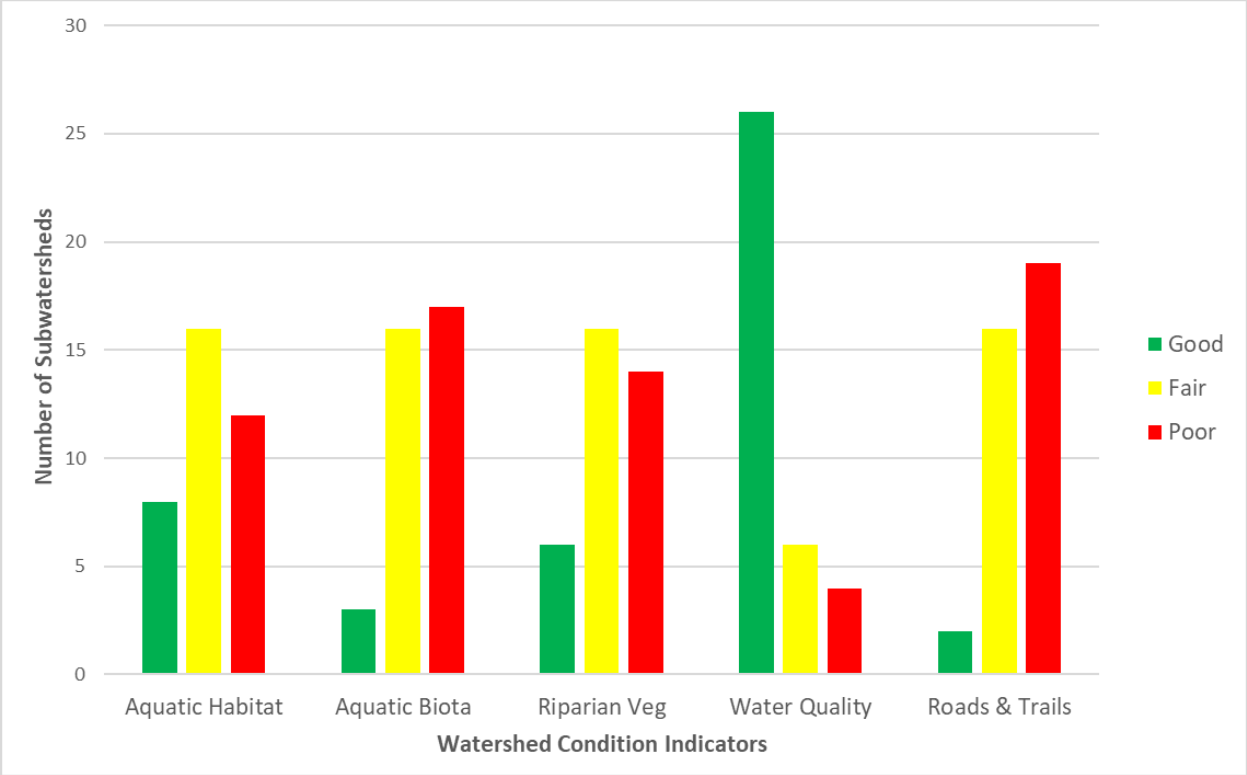

Figure 1. Number of subwatersheds by condition class for selected indicators.

Watershed function and health, as they relate to roads and trails, were based on factors that include open road density, maintenance investment, and proximity to water. Two were rated in good condition, 16 rated in fair condition, and 19 watersheds rated poor condition. Road management is an ongoing agency emphasis, with national direction for transportation analysis to identify a 'sustainable' (economic, social, and ecological) road system, and develop a plan to reduce road impacts. Ongoing challenges include desire for public access for various purposes, needs for access for resource management and protection, and diminished funding for maintenance and storage or decommissioning of unneeded roads.

The desired condition is to have watershed function maintained or improved towards functioning properly (Good Rating). Watersheds would exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Tree density would be reduced and moving toward the historical range. Unneeded roads would be decommissioned or restored to their natural condition improving the road and

trail indicator. Soil and riparian condition and function would be improved and moving towards satisfactory and properly functioning.

Riparian Condition

Riparian Condition by aquatic species was determined averaging the WCATT scores for the riparian vegetation indicator for all subwatersheds within a species action area. This provides an overview of the riparian condition as it relates to each species and their associated habitat. Averages from 1-1.4 are considered Good, 1.5-2.4 is Fair, and 2.5-3.0 is Poor (Table 4).

Four species have riparian condition rated in good condition which equates to functioning properly. Proper functioning condition indicates adequate vegetation, landform, and/or large woody debris are present to:

- Dissipate stream energy associated with high waterflow, thereby reducing erosion and improving water quality.
- Capture sediment and aid floodplain development.
- Improve flood-water retention and ground-water recharge.
- Develop root masses that stabilize streambanks against erosion.
- Maintain channel characteristics.

These watersheds have native vegetation in proper functioning condition throughout the stream corridor or along wetlands and water bodies. Native plant communities are vigorous, healthy and diverse in age, structure, cover and composition on >80% of the riparian/wetland areas in the watershed. Sufficient reproduction of native species is occurring to ensure sustainability. Mesic herbaceous plant communities occupy most of their site potential and vegetation is in a dynamic equilibrium appropriate to the system.

Six species have riparian condition rated in fair condition, which is considered Functioning at Risk. These riparian areas are in limited functioning condition; however, existing hydrologic, vegetative, or geomorphic attributes make them susceptible to impairment. Disturbance partially compromises proper functioning condition of native vegetation attributes along stream corridors, wetlands, or water bodies. Native vegetation demonstrates a moderate loss of vigor, reproduction and growth, or changes in composition; particularly in areas most susceptible to human impact. Areas displaying light to moderate impact to structure, composition and cover may occupy 25 to 80% of the overall riparian area with only a few areas displaying significant impacts. Up to 25% of species cover or composition occurs from early seral species, but the communities across the watershed are still dominated by mid to late seral stages. Xeric herbaceous communities exist where water relationships have been altered but are relatively small, localized, and do not dominate across the watershed.

Four species have riparian condition rated in poor condition, which are considered Impaired. These riparian areas clearly are not providing adequate vegetation, landform, or woody material to dissipate stream energy associated with moderately high flows, and thus are not reducing erosion, improving water quality, etc. large percentage of native vegetation attributes along stream corridors, wetlands, and water bodies are not in proper functioning condition. Native vegetation is vigorous, healthy and diverse in age, structure, cover and composition on <75% of the riparian/wetland areas in the watershed. Native vegetation demonstrates a noticeable loss of vigor, reproduction and growth, and changes in composition as compared with site potential communities. In these areas, cover and composition are strongly reflective of early seral species dominance although there will be late and mid seral species present in pockets. Mesic dependent herbaceous vegetation is limited in extent with many lower terraces dominated

by xeric species most commonly associated with uplands. Reproduction of mid and late seral species is very limited. For much of the area, the water table is disconnected from the riparian area and the vegetation reflects this loss of available soil water.

Table 4. Average Riparian Condition from WCATT for species analysis areas.

Species	Riparian Condition	Associated Rating
Gila trout	2.3	Fair
Gila chub	2	Fair
Gila topminnow	1	Good
Little Colorado spinedace	2.3	Fair
Loach minnow	1	Good
Razorback sucker	1	Good
Spikedace	1	Good
Narrow-headed gartersnake	2.5	Poor
Northern Mexican gartersnake	2.7	Poor
Desert sucker	2.6	Poor
Sonoran sucker	2.7	Poor
Little Colorado sucker	2.3	Fair
Headwater chub	2.4	Fair
Roundtail chub	2	Fair

Ecological Restoration Units (Vegetation Types)

Ecological Response Units (ERUs) are map unit constructs, technical groupings, from the National Vegetation Classification. Each unit combines finer scale vegetation classes that share similar ecosystem processes and successional dynamics as well as potential vegetation under historic disturbance regimes. These units are supposed to facilitate landscape analysis and strategic planning.

The Rim Country project area contain six overarching ERU types: riparian, human/other, grassland, shrubland, woodland, and forest. These types encompass a total of 25 ERUs varying in overall acreage within the project area (Table 5). Riparian and human/other ERUs occur on approximately 22,300 acres (<2% of project area) and represent vegetation types most closely associated with aquatic species and habitats analyzed in this report. However, it should also be noted that many high elevation streams are within Forested ERUs where vegetation such as ponderosa pine or mixed conifer are providing riparian functions such as stream shading and bank stabilization.

Table 5. Acreages of Ecological Restoration types and individual Ecological Restoration Units (ERUs) within the entire Rim Country Project Area.

ERU Type	ERU	Acres
Riparian		**21,326**
	Arizona Alder - Willow	228
	Arizona Walnut	68
	Fremont Cottonwood - Conifer	169
	Fremont Cottonwood / Shrub	539
	Herbaceous Riparian	4,270
	Historic Riparian - Residential/Urban	298
	Narrowleaf Cottonwood / Shrub	7,584
	Ponderosa Pine / Willow	5,607

ERU Type	ERU	Acres
	Sycamore - Fremont Cottonwood	946
	Willow - Thinleaf Alder	1,617
Human/Other		**974**
	Water	974
Grasslands		**38,758**
	Colorado Plateau / Great Basin Grassland	14,086
	Montane / Subalpine Grassland	24,672
Shrubland		**2,542**
	Gambel Oak Shrubland	0
	Interior Chaparral	2,542
Woodland		**97,787**
	Juniper Grass	2,409
	Madrean Encinal Woodland	16,457
	Madrean Pinyon-Oak Woodland	3,868
	PJ Evergreen Shrub	27,150
	PJ Grass	10,087
	PJ Woodland	37,815
Forest		**1,076,784**
	Mixed Conifer - Frequent Fire	106,633
	Mixed Conifer w/ Aspen	62,700
	Ponderosa Pine Forest	749,600
	Ponderosa Pine / Evergreen Oak	157,849
Total		**1,238,171**

Riparian areas are directly coupled to streams, the portions of watersheds required for maintaining hydrologic, geomorphic, and ecological processes that directly affect streams, stream processes, and aquatic habitats. Riparian areas are shaped by disturbances characteristic of upland ecosystems, such as fire and windthrow, as well as disturbance processes unique to stream systems, such as lateral channel erosions, peakflows, depositions by floods and debris flows. The near-stream riparian areas and floodplains may contain an increased diversity of plant species and extensive hydrologic nutrient cycling interactions between groundwater and riparian vegetation. This vegetation, ranging from conifers to deciduous hardwoods, provides organic debris to stream channels and associated aquatic invertebrate communities. Further, riparian vegetation moderates light exposure and stream temperature, helps armor stream banks with extensive root systems, and contributes large wood into the stream channel.

Stream-riparian ecosystems naturally experience periodic catastrophic disturbances, which then moved through a series of recovery states over a period of decades to centuries, resulting in a landscape that varies in suitability for aquatic species. A pulse disturbance is one that allows an ecosystem to recovery to pre-disturbance conditions, and a press disturbance is one that prohibits an ecosystem from rebounding to pre-disturbance conditions. The dominant pulse disturbances aquatic species are adapted to include natural fire regimes, fire related landslides, and floods, all working in concert in a manner that produce habitat patches, varying in quality and quantity. In short, fires would burn through an area, landslides and mass wasting would distribute the sediment and debris throughout stream networks. The pulse disturbance regime, or varying forms thereof, was altered with the onset of fire suppression and extensive timber harvest. The resulting effects are different from the natural pulse regime in that sediment is transported in the system without wood, the interval between disturbances had been drastically reduced in

most cases, and harvest and road construction is widely distributed, resulting in chronic sedimentation across a larger landscape.

Streams and Aquatic Species

The Rim Country proposed project area encompasses the headwaters of three major river basins in Arizona; the Salt, Verde, and Little Colorado Rivers. There are approximately 4,055 miles of stream channels within the proposed project area, including ephemeral, intermittent, and perennial channels (Table 6). Ephemeral steams only carry water during runoff and do not support riparian vegetation. Intermittent and perennial streams support riparian vegetation and various species that use those habitats. USGS defines ephemeral streams at channels above the water table at all times and only flow in direct response to precipitation (runoff). Therefore, they do not support riparian vegetation. Intermittent streams flow receive water from rainfall runoff, springs, or other surface sources such as snowmelt. Perennial streams normally have water in the channel at all times. Therefore, intermittent and perennial streams are capable of supporting riparian vegetation and providing aquatic habitat. Of these streams, approximately 360 miles are occupied or suitable habitat for aquatic species such as fish, gartersnakes, mollusks, and invertebrates.

Table 6. Miles of each stream type within the Rim Country project area.

Forest	Ephemeral	Intermittent	Perennial	Total
Apache-Sitgreaves NF	719.6	876.3	51.6	1647.5
Coconino NF	23.9	1,077.0	118.9	1,219.8
Tonto NF	1.3	969.5	217.3	1188.1
Total	**744.8**	**2,922.8**	**387.8**	**4,055.4**

Most streams and aquatic and riparian habitats have experienced considerable degradation and alteration from a variety of human and management related activities (Rinne 1994, Rinne and Minckley 1991); their ability to recover and improve has been affected, especially as ongoing and new impacts occur. Habitat quality and complexity have resulted from loss of pool habitat, loss of large wood within streams, riparian area impacts, channel alterations, and down cutting. Increased sedimentation rates can adversely impact habitat and species through negative impacts to water quantity and quality. Fish population surveys and sampling efforts have also shown declines for some species, while some non-native species have shown increases.

Decline of aquatic species and their habitats can be traced to a variety of factors that are common in the western United States. These include major and minor dams, water diversions, channelization, and groundwater mining for irrigation and municipal use (Rinne 1994); sediment (Newcombe and MacDonald 1991), land management activities including grazing ((Belsky et al. 1999; Ohmart 1996 Zwartes et al. 2005), road construction Trombulka and Frissell 2000), and timber-harvest; increased fuel loading leading to uncharacteristic wildfire (Rieman et al, 2003; Young et al., 2002), loss of riparian vegetation through land conversion; and introduction of species for sport fishing (Post et al. 2002). The pattern of degradation in aquatic habitats and communities closely parallels human settlement and land use. Concurrent with the extensive modification of aquatic habitats was the introduction of nonnative species that leading to competition, hybridization, and predation with native fishes (Rahel 2000; Rinne 1994; Rinne and Minckley 1991). Native fish populations have been reduced from large interconnected populations to isolated populations within severely altered and degraded habitats. All the native species

have lost much of their population redundancy within and outside the forests. This is reflected in the historic and recent population declines and fragmentation of fish species in the Southwest.

The native aquatic species and habitats analyzed here have persisted environmental disturbances altering them from historic conditions. (e.g., fire and suppression of fire, climate variation, degraded watersheds and aquatic habitat, altered hydrologic conditions, loss of riparian and aquatic habitat, recreation demands, non-native species introductions, roads). While most of these impacts have occurred slowly over many decades, the individual and collective impacts still remain today. Current conditions for aquatic species and habitats at the 5th level HUC watershed can be attributed to many factors. Diversions and water withdrawals reduce surface waters and alter flowing streams into intermittent streams, reservoirs, or dewatered channels reducing available habitat. Stream channelization for flood control or from altered hydrologic regimes reduces riparian and aquatic habitat quantity and quality. Competition and predation by non-native species has also reduced native populations. Other general factors that have directly or indirectly altered habitats include roads, recreation, livestock grazing, timber harvest and fire suppression.

Federally listed and Forest Sensitive Species lists for all three Forests were screened to determine species that occur or have suitable habitat with the project and action area. Eleven federally listed species and nineteen sensitive aquatic species occur within the three Forests. Of those, nine federally listed and sixteen sensitive individual species will be analyzed in detail (Table 7). Two of the species (gartersnakes) are both federally listed and sensitive species.

Table 7. Federally listed and Forest Service Sensitive aquatic species and/or their habitat expected to occur within the Rim Country project area.

Species	Status	Occurrence	Notes
Gila trout (*Oncorhyncus gilae*)	Federally Threatened	Documented Occurrence	Occurs within the Project and Action areas
Little Colorado Spinedace (*Lepidomeda vittata*)	Federally Threatened, with designated Critical Habitat	Documented Occurrence	Occurs within the Project and Action areas
Gila chub *(Gila intermedia)*	Federally Endangered with designated Critical habitat	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Gila topminnow *(Poeciliopsis occidentalis occidentalis)*	Federally Endangered	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Razorback sucker *(Xyrauchen texanus)*	Federally Endangered with designated Critical habitat	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Loach minnow *(Tiaroga cobitis)*	Federally Endangered with designated Critical habitat	Documented Occurrence	Does not occur within the Project Area, but does occur in

Species	Status	Occurrence	Notes
			watersheds within the project boundary.
Spikedace *(Meda fulgida)*	Federally Endangered with designated Critical habitat	Documented Occurrence	Does not occur within the Project Area, but does occur in watersheds within the project boundary.
Narrow-headed gartersnake (*Thamnophis rufipunctatus*)	Federally Threatened, with proposed Critical Habitat & Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Northern Mexican gartersnake (*Thamnophis eques*)	Federally Threatened, with proposed Critical Habitat & Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Desert sucker *(Catostomus clarki)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Sonoran sucker *(Catostomus insignis)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Little Colorado sucker *(Catostomus sp. 3)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Headwater chub *(Gila nigra)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Roundtail chub *(Gila robusta)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area
Netwing Midge *(Agathon arizonicus)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Project Area.
A Mayfly *(Fallceon eatoni)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Stonefly *(Capnia caryi)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
Parker's cylloepus riffle beetle *(Cylloepus parkeri)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Mayfly *(Fallceon eatoni)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Mayfly *(Moribaetis mimbresaurus)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.

Species	Status	Occurrence	Notes
A Caddisfly *(Lepidostoma apache)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Caddisfly *(Lepidostoma knulli)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the Project Area.
A Caddisfly *(Limnephillus granti)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat of springs in ponderosa pine exist.
A Caddisfly *(Wormaldia planae)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Action area
Ferris' Copper *(Lycaena ferrisi)*	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat of herbaceous wetlands exist.
Nokomis Fritillary (aka Great Basin Silverspot) *(Speyeria nokomis nokomis)*	Forest Service Sensitive	Documented Occurrence	Little is known about the species, but suitable habitat of herbaceous wetlands and streams exist.
Fossil springsnail *(Pyrgulopsis simplex)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Action area
California floater *(Anodonta californiensis)*	Forest Service Sensitive	Documented Occurrence	Occurs within the Project and Action areas
Species Not Analyzed in Detail			
Apache trout *(Oncorhyncus gilae apache)*	Federally Threatened	No Documented Occurrence	Does not occur within the Project or Action Area
Colorado pikeminnow *(Ptychochelus lucius)*	Experimental-Nonessential Population	No Documented Occurrence	Does not occur within the Project or Action Area
A Caddisfly *(Wormaldia planae)*	Forest Service Sensitive	Not Suspected to Occur	Does not Occur in the Project Area, and elevation range is lower than that of the project.
Balmorhea Saddle-Case Caddisfly *(Protoptila balmorhea)*	Forest Service Sensitive	Not Suspected to Occur	Does not Occur in the Project or Action Area, associated ERU semidesert grassland does not occur.

Threatened and Endangered Species Analyzed in Detail

Gila trout *(Oncorhynchus gilae gilae)*

Status: Threatened (USDI 2006).

Life history, ecology, historical distributions and abundances, habitat requirements, and other information relevant to this species are limited; and data and information that has been collected has primarily occurred on the Gila NF in New Mexico. Some of this information has been summarized and reviewed within the four Gila Trout Recovery Plans, the first version completed in 1979 and the latest version in 2003. Over the last 15+ years, the Arizona Game and Fish Department and Forest Service have implemented some recovery actions to improve the species status in Arizona; however, wildfires and drought have impacted those efforts.

The historical distribution of Gila trout has been somewhat confused with that of Apache trout. Originally Apache trout were thought to have historically occurred and occupied the headwaters of the Little Colorado, Salt, and San Francisco Rivers. The more recent view is that the headwaters of the San Francisco River were historically occupied by the Gila trout. The San Francisco River headwaters are now considered within historic range of Gila trout, although some Apache trout populations are still present from past recovery actions (i.e., Coleman, Grant, and KP Creeks).

In Arizona, four streams currently have Gila trout. On the Coconino NF, a recreational Gila trout population exists in West Fork Oak Creek and a recovery population was stocked in Dude Creek and Chase Creek on the Tonto National Forest. Gila trout occurred on the Coronado NF in Ash, and Frye Creeks; it is believed that both populations were lost in 2017 after the Frye Fire. Potential recovery streams include Chase, Ellison, Haigler, Webber, Marijilda, Raspberry, KP, Coleman, and Grant Creeks. Potential recreational fisheries include Christopher Creek, East Verde River, and Workman Creek.

Threats to the species include the destruction, modification, and curtailment of its habitat or range; livestock grazing; fire; timber harvest operations and the associated erosion, siltation, and increases in water temperatures; and the introduction of nonnative trout species that hybridize and compete with the Gila trout. Further information on this species can be found at:
https://www.fws.gov/southwest/es/arizona/Gila_Trout.htm

Habitat in the Analysis Area

Gila trout occur in approximately 32 miles of streams within the project area (Table 8). The six streams are either currently occupied by the species or provide suitable habitat for recovery efforts.

Table 8. Miles of streams and associated 6th Code subwatersheds with Gila trout within the Rim Country proposed project area.

Stream Name	6th HUC subwatershed	Stream miles in Project Area
Chase Creek		**4.4**
	East Verde River Headwaters	4.4
Christopher Creek		**8.2**
	Bull Tank Canyon-Tonto Creek	0.0
	Christopher Creek	8.1
Dude Creek		**2.2**
	East Verde River Headwaters	2.2

Stream Name	6th HUC subwatershed	Stream miles in Project Area
Ellison Creek		**4.4**
	Ellison Creek – East Verde River	4.4
Haigler Creek		**8.9**
	Haigler Creek	8.9
Workman Creek		**4.0**
	Workman Creek	4.0
Grand Total		**32.1**

Six watersheds (6th HUCs) contain Gila trout streams within the project area. Riparian condition within these watersheds ranges from Properly Functioning (n=1) to Impaired (n=3) (Table 9). The average riparian condition for Gila trout watersheds is 2.3, which equates to Functioning at Risk.

Table 9. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Gila trout within the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Bull Tank Canyon-Tonto Creek	3	Poor
Christopher Creek	3	Poor
East Verde River Headwaters	3	Poor
Ellison Creek-East Verde River	2	Fair
Haigler Creek	2	Fair
Workman Creek	1	Good
Average	**2.3**	**Fair**

Little Colorado Spinedace *(Lepidomeda vittata)* and designated Critical Habitat

Status: Threatened with designated critical habitat (USFWS, 1987).

The natural history of Little Colorado spinedace can be found in the Recovery Plan (USDI 1987), and the 5-Year Review (USFWS 2008). The Little Colorado spinedace is a member of the Cyprinidae family and is typically less than 10 cm long. This species is predacious, feeding on aquatic and terrestrial insects, as well as filamentous algae. Spinedace inhabits medium to small streams and is characteristically found in pools with water flowing over fine gravel and silt-mud substrates. Many of the streams are seasonally intermittent, at which times the Little Colorado spinedace persists in the deep pools that retain water. During flooding the spinedace redistributes itself throughout the stream. Spawning primarily occurs in late-spring to early-summer but can extend to the fall. Typical habitat ranges in elevation from 4,000 to 8,000 feet.

Past threats and declines of this species have resulted from habitat alterations and loss due to impoundment, removal of water from streams, channelization, grazing, road building, urban growth, and other human activity. Their decline is also related to the introduction and spread of non-native predatory and competitive fish species, and the use of pesticides (ichthyotoxins) in many of its native streams. Current threats to the survival of the species include changes in stream flow patterns, declines in water quality and quantity, modifications of watersheds (logging, dams, road construction), manipulations of fish populations (use of chemicals and other factors) and interactions with introduced fishes and other aquatic species. Recent impacts to the species are due to drought, non-native species, and alteration of natural hydrographs in occupied habitat. Livestock and wild ungulate grazing have also been identified as

contributing to poor watershed conditions which exacerbate the effects of drought and result in diminished habitat quality. Fuels reduction, forest restoration projects, and fire management actions have also contributed to altered hydrographs and sediment loads in streams occupied by spinedace. Further information on Little Colorado spinedace can be found at:
https://www.fws.gov/southwest/es/arizona/Little.htm

Based on the 5-Year Review spinedace are consistently located in West Leonard and Leonard Canyons, Lower Chevelon Creek on private land, Little Colorado River on two AZGFD properties, Rudd Creek, and Nutrioso Creek.

The most recent survey and habitat data for each watershed are indicated below from the 5-Year Status Review (USFWS 2008).

Chevelon Creek Watershed: Currently, spinedace occupies a section of Chevelon Creek, several miles upstream of Chevelon Creek's confluence with the LCR on the privately own Rock Art Ranch. Chevelon Creek through the Rock Art Ranch supports robust populations of spinedace, where large schools of fish (40-50 individuals) can be seen swimming in pools downstream of The Steps, something not seen in any other currently occupied area.

On July 23, 2007, AZGFD stocked 95 spinedace into five pools on West Chevelon Creek on the ASNFs. This tributary to middle Chevelon Creek contains only native fish at this time and is expected to provide habitat for spinedace. In July 2008, surveys located spinedace within the perennial pools where they were originally stocked and downstream of the area in ephemeral reaches. It is unclear how many fish are still present or if they spawned in 2008. Further surveys and stockings of this area are needed in order to ensure that spinedace persist in West Chevelon Creek if it is to contribute to recovery.

East Clear Creek Watershed: Spinedace currently occupy small, perennial pool habitats in West Leonard Canyon, Leonard Canyon (including Dines Tank), Bear Canyon, Dane Canyon, and Yeager Canyon. These populations and available habitat are all relatively small throughout the watershed, but West Leonard and Leonard Canyons continue to be one of the most dependable locations to find spinedace in the entire watershed. Bear, Dane, and Yeager Canyon populations are sustained by moving spinedace from West Leonard Canyon and Dines Tank to these areas. Spinedace were introduced into Turkey Creek and Gentry Creek in September 2018; future surveys will determine if the stocking is successful as well as if the population becomes self-sustaining in the future.

Designated critical habitat for the species occurs in East Clear Creek within the project area and is occupied.

Habitat in the Analysis Area

Little Colorado spinedace occur or have suitable habitat in approximately 187 miles of streams within the project area (Table 10). The seven streams are either currently occupied by the species or provide suitable habitat for recovery efforts. Two sections of East Clear Creek are identified as designated critical habitat within the project area: 13 miles of stream above Blue Ridge Reservoir and 18 miles of stream from the confluence of Leonard Canyon upstream to Blue Ridge Reservoir.

Table 10. Miles of streams and associated 6th Code subwatersheds (HUC) with Little Colorado spinedace within the Rim Country proposed project area.

Stream Name	6th HUC subwatershed	Total
Alder Creek		**5.1**
	Alder Canyon	5.1
Barbershop Canyon		**14.7**
	Barbershop Canyon	14.7
	East Clear Creek-Clear Creek	0.0
Bear Canyon		**7.0**
	Bear Canyon	7.0
Beaver Canyon		**5.0**
	Gentry Canyon	5.0
Buck Springs Canyon		**7.1**
	Leonard Canyon	7.1
Chevelon Creek		**19.9**
	Durfee Draw-Chevelon Canyon	7.7
	Long Tom Canyon-Chevelon Canyon	8.7
	Upper Chevelon Canyon-Chevelon Canyon Lake	3.6
	Woods Canyon and Willow Springs Canyon	0.0
Dane Canyon		**4.4**
	Barbershop Canyon	4.4
East Clear Creek		**34.1**
	East Clear Creek-Blue Ridge Reservoir	14.1
	East Clear Creek-Clear Creek	20.0
	Leonard Canyon	0.0
	Miller Canyon	0.0
Gentry Canyon		**3.9**
	Gentry Canyon	3.9
Houston Draw		**6.1**
	Bear Canyon	6.1
Kehl Canyon		**4.5**
	East Clear Creek-Blue Ridge Reservoir	4.5
Leonard Canyon		**23.7**
	Leonard Canyon	23.7
Turkey Creek		**7.3**
	Gentry Canyon	7.3
West Chevelon Creek		**4.2**
	Upper West Chevelon Canyon	4.2
West Leonard Canyon		**3.2**
	Leonard Canyon	3.2
Willow Creek		**22.5**
	East Clear Creek-Clear Creek	0.0
	Gentry Canyon	0.0
	Lower Willow Creek	13.3
	Upper Willow Creek	9.2
Yeager Canyon		**14.0**
	East Clear Creek-Clear Creek	14.0
Grand Total		**186.9**

Fifteen watersheds (6th HUCs) contain Little Colorado spinedace streams within the project area. Riparian condition within these watersheds ranges from Properly Functioning (n=3) to Impaired (n=7) (Table 11). The average riparian condition for Little Colorado spinedace watersheds is 2.3, which equates to Functioning at Risk.

Table 11. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Little Colorado spinedace within the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Alder Canyon	2	Fair
Barbershop Canyon	3	Poor
Bear Canyon	3	Poor
Durfee Draw-Chevelon Canyon	1	Good
East Clear Creek-Blue Ridge Reservoir	3	Poor
East Clear Creek-Clear Creek	2	Fair
Gentry Canyon-Upper Clear Creek	3	Poor
Leonard Canyon	3	Poor
Long Tom Canyon-Chevelon Canyon	1	Good
Lower Willow Creek	2	Fair
Miller Canyon	3	Poor
Upper Chevelon Canyon-Chevelon Canyon Lake	1	Good
Upper West Chevelon Canyon	2	Fair
Upper Willow Creek	3	Poor
Woods Canyon and Willow Springs Canyon	2	Fair
Average	**2.3**	**Fair**

Gila chub *(Gila intermedia)* and designated Critical Habitat

Status: Endangered with designated critical habitat (USFWS, 2005).

Life history, ecology, historical distributions and abundances, habitat requirements, and other information relevant to this species are limited. Most of the available information for this species has been summarized and reviewed within the Proposed and Final Rules for the "Listing Gila Chub as Endangered with Critical Habitat" completed in 2002 and in 2005, respectively. This species is found in pools in smaller streams and cienegas ranging in elevation from approximately 600 to 1675 meters. They are highly secretive, and adults prefer deeper water in pools and eddies below riffles or runs; often remaining in cover from terrestrial vegetation, boulders, and fallen logs. Young use the shallow margins of pools with aquatic vegetation or debris for cover, while older juveniles may be found in higher velocity runs and riffles. Primary food items are aquatic and terrestrial insects and filamentous algae. Breeding primarily occurs in late spring to summer, males follow the larger females over beds of aquatic plants, and there is no parental care of the young. Temperature may be the primary cue for initiation of spawning.

Gila chub are becoming rare, especially where land use practices such as overgrazing lead to incision of floodplains and lowering of water tables, which, in turn, drain marshlands and other stream-associated

habitats. Threats to the chub include introduction of nonnative aquatic competitors and predators (e.g., fish, bullfrogs, and crayfish), continued water use for development purposes, and habitat degradation due to improper land management on the watershed. Erosion from roads or off bare ground on the watersheds can fill in the deep pools needed by the species, thus degrading the habitat. Where it is still present, populations are often small, fragmented, and at risk from known and potential threats and from random events such as drought, flood events, and wildfire. Further information on the species can be found at: https://www.fws.gov/southwest/es/arizona/GilaChub.htm

Habitat in the Analysis Area

Gila chub and their designated habitat do not occur within the project boundary. They do occur directly downstream of the project area in Red Tank Draw and Spring Creek on the Tonto NF. Approximately 11,600 acres of the Red Tank Draw watershed (32%) and 10,000 acres of the Upper Spring Creek watershed (47%) occur within the project area. No designated critical habitat occurs within the project area.

Two watersheds (6th HUCs) contain Gila chub streams within the project area. Riparian condition for both watersheds is rated as Functioning at Risk (Table 12). The average riparian condition for Gila chub watersheds is 2.0, which equates to Functioning at Risk.

Table 12. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Gila chub within the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Red Tank Draw	2	Fair
Upper Spring Creek	2	Fair
Average	**2.0**	**Fair**

Gila topminnow *(Poeciliopsis occidentalis occidentalis)*

Status: Endangered (USFWS 1967).

The Gila topminnow is a small, guppy-like, live-bearing fish. It occurs in small streams, springs, and cienegas below 4,500 ft. elevation, primarily in shallow areas with aquatic vegetation and debris for cover. It can tolerate relatively high water temperatures and low dissolved oxygen. Breeding occurs primarily during January through August, but in thermally constant springs young may be produced through the year. Gila topminnow are opportunistic omnivorous feeders. Primary food includes detritus, vegetation, amphipods, ostracods, and insect larvae.

Historically, it was one of the most common fish throughout the Gila River drainage in Arizona, Mexico, and New Mexico. Currently, most of the remaining naturally occurring populations in are in the Santa Cruz River system. The species occurs in small streams, springs and cienegas in Gila, Pinal, Graham, Yavapai, Santa Cruz, Pima, Maricopa, and La Paz counties, Arizona. It has been released at almost 200 locations in efforts to reestablish populations.

Impacts to the species include introduction and spread of nonindigenous predatory and competitive fishes, water impoundments and diversions, water pollution, groundwater pumping, stream channelization, and habitat modification. Further information on this species can be found at: https://www.fws.gov/southwest/es/arizona/Gila_Top.htm

Habitat in the Analysis Area

Gila topminnow does not occur within the project area, but does occur within the action area. The species occurs in Fossil Creek directly downstream of the project area in the Upper Fossil Creek subwatershed. Approximately, 12,300 acres of that watershed (48%) occur within the project area.

Only one watershed (6th HUC) contains a Gila topminnow stream within the project area. Riparian condition for the watershed is rated as Functioning Properly (Table 13).

Table 13. Riparian condition score from Watershed Condition Framework for 6th Code HUCs with Gila topminnow within the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Upper Fossil Creek	1	Good
Average	**1.0**	**Good**

Razorback sucker *(Xyrauchen texanus)* and designated Critical Habitat

Status: Endangered (USDI 1991) with designated critical habitat (USDI 1994)

The razorback sucker, also known as the humpback sucker, is a member of the Catostomidae family. The species can grow more than 600mm (2 feet) in length, weigh more than 3kg (6 pounds), and live over 40 years. The species is a bottom-feeder, whose diet includes planktonic crustaceans, diatoms, filamentous algae, and detritus. Spawning occurs in the lower Colorado River basin from January through April. Spawning occurs over mixed substrates that range from silt to cobble and at water temperatures ranging from 10.5 to 21º C (51 to 70º F). Razorback sucker inhabit riverine systems which provide a wide variety of habitats including backwaters, sloughs, oxbow lakes, and seasonally inundated flood plains, which are used to satisfy various life history requirements. Adult razorback suckers prefer shallow and swift waters of mid-channel sandbars (less than 12 feet in depth) during the summer months and slow runs, slack waters, and eddies in the winter. The Razorback Sucker Recovery Plan describes the life history and habitat use for this species in detail.

Detailed information relative to the distribution and abundance of the razorback sucker can be found in the Recovery Plan (USDI 1999). Razorback sucker occur in the Verde and Salt Rivers with designated critical habitat in both systems. Razorback sucker have been stocked in the Verde River on a regular basis since the 1980s. Stockings in the Salt River sub-basin have not occurred since the early 1990s. Surveys do detect the species in the Verde River. However, a viable population is not thought to be extant.

Decline of the razorback sucker has been associated with major changes in its riverine ecosystem including water diversion, water depletion, and construction and operation of dams. The species decline is also attributed to predation by green sunfish, warmouth, channel catfish, flathead catfish, threadfin shad, smallmouth bass, and largemouth bass. Further information on this species can be found at: https://www.fws.gov/southwest/es/arizona/Razorback.htm

Habitat in the Analysis Area

Razorback sucker does not occur within the project area, but does occur within the action area. The species occurs in Fossil Creek directly downstream of the project area in the Upper Fossil Creek

subwatershed. Approximately, 12,300 acres of that watershed (48%) occur within the project area. No designated critical habitat occurs within the project area.

Only one watershed (6th HUC) contains a Razorback sucker stream within the project area. Riparian condition for the watershed is rated as Functioning Properly (Table 14).

Table 14. Riparian condition score from Watershed Condition Framework for 6th Code HUCs with Razorback sucker within the Rim Country proposed project area.

Occupied 6th HUC	WCATT Riparian Condition Score	Associated Rating
Upper Fossil Creek	1	Good
Average	**1.0**	Good

Loach minnow *(Tiaroga cobitis) and designated Critical Habitat*

Status: Endangered with designated critical habitat (USDI 2012).

Loach minnows are found in turbulent, rocky riffles of rivers and tributaries from approximately 2,300 to 8,000 feet in elevation. Loach minnow are bottom-dwelling inhabitants of shallow, swift waters flowing over gravel and cobble substrates in mainstream rivers and tributaries. They use the spaces between, and the protective shelter of larger substrates for resting and spawning. The species is rare or absent from habitats where fine sediments fill the spaces between larger substrate. The first spawn of loach minnow generally occurs in their second year, primarily from March through May; and they may also spawn in the fall. Spawning occurs in the same riffles occupied by adults during the non-spawning season. The adhesive eggs of the loach minnow are attached under the downstream side of a rock that forms the roof of a small cavity in the substrate. Longevity is typically 15 months to two years, although loach minnow can live as long as three years. Loach minnow feed exclusively on aquatic insects; and they are opportunistic bottom-feeding insectivores, feeding primarily on riffle-dwelling larval mayflies and midges. They actively seek their food on bottom substrates, rather than pursuing food items in the drift.

During the last century, both the distribution and abundance of the loach minnow has been greatly reduced throughout the species range. Competition and predation by nonnative fish and habitat destruction have reduced the historic range of the loach minnow by about 85 percent. Both historic and present landscapes surrounding loach minnow habitats have been impacted to varying degrees by domestic livestock grazing, mining, agriculture, timber harvest, recreation, development, or impoundments. These activities degrade loach minnow habitats by altering flow regimes, increasing watershed and channel erosion and thus sedimentation, and adding contaminants to streams and rivers. As a result, these activities may affect loach minnow through direct mortality, interference with reproduction, and reduction of invertebrate food supplies. Further information on this species can be found at: https://www.fws.gov/southwest/es/arizona/Loach.htm

Habitat in the Analysis Area

Loach minnow does not occur within the project area, but does occur within the action area. The species was stocked into Fossil Creek directly downstream of the project area in the Upper Fossil Creek subwatershed, it does not appear to have established. Approximately, 12,300 acres of that watershed (48%) occur within the project area. No designated critical habitat occurs within the project area.

Only one watershed (6th HUC) contains a Loach minnow stream within the project area. Riparian condition for the watershed is rated as Functioning Properly (Table 15).

Table 15. Riparian condition score from Watershed Condition Framework for 6th Code HUCs with Loach minnow within the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Upper Fossil Creek	1	Good
Average	**1.0**	**Good**

Spikedace *(Meda fulgida)*

Status: Endangered with designated critical habitat (USDI 2012).

Adult spikedace are 2.5 to 3.0 inches long; the eyes are large, the snout fairly pointed, and the mouth is slightly sub-terminal with no barbells present. The species is slender and somewhat anteriorly compressed. Spikedace can live up to 24 months, although few survive more than 13 months; and reproduction occurs primarily in one-year-old fish. Spawning extends from the middle of March into June and occurs in shallow riffles with gravel and sand bottoms and moderate flow. By the middle of May, most spawning has occurred, although in years of high water flows, spawning may continue into late May or early June. Spikedace feed primarily on aquatic and terrestrial insects.

Spikedace occupy mid-water habitats usually less than 3 feet deep, with slow to moderate water velocities over sand, gravel, or cobble substrates. Adults often occur in shear zones along gravel-sand bars where rapid water borders slower flow, quiet eddies on the downstream edges of riffles, and broad shallow areas above gravel-sand bars. The preferred habitat of the spikedace varies seasonally and with maturation. In winter, the species congregates along stream margins with cobble substrates. The erratic flow patterns of southwestern streams that include periodic and recurrent flooding are essential to the feeding and reproduction of the spikedace by scouring the fine sediment and keeping gravels clean. Spikedace larvae and juveniles tend to occupy shallow, peripheral portions of streams that have slow currents and sand or fine gravel substrates, but will also occupy backwater habitats.

The spikedace is native to the Gila River drainage, including the San Francisco drainage, except in the extreme headwaters. Relict spikedace populations exist only in the upper Verde River and Aravaipa Creek in Arizona and portions of the Gila River in New Mexico. Although, spikedace have not been collected in the Verde River in recent years. In New Mexico the species is generally absent from the Gila River from the confluence of the West and East Forks downstream to the mouth of Turkey Creek, and occurs irregularly downstream from the mouth of the Middle Box of the Gila River to the Arizona-New Mexico state line. There are reestablished populations in the Blue River AZ, San Francisco River NM, and Fossil Creek AZ.

The majority of historic habitat for the spikedace has been drastically altered or destroyed by human uses of the rivers, streams, and watersheds. Causes of such alterations and degradation include damming, water diversion, channel down-cutting, excessive groundwater pumping, lowering water tables, channelization, riparian vegetation destruction, erosion, mining, grazing, and other watershed disturbances. An increasing threat to spikedace includes the introduction and spread of non-native species that compete or predate upon spikedace. Further information on this species can be found at:
https://www.fws.gov/southwest/es/arizona/Spikedace.htm

Habitat in the Analysis Area

Spikedace does not occur within the project area, but does occur within the action area. The species occurs in Fossil Creek downstream of the project area in the Upper Fossil Creek subwatershed. Approximately, 12,300 acres of that watershed (48%) occur within the project area. No designated critical habitat occurs within the project area.

Only one watershed (6th HUC) contains a Spikedace stream within the project area. Riparian condition for the watershed is rated as Functioning Properly (Table 16).

Table 16. Riparian condition score from Watershed Condition Framework for 6th Code HUCs with Spikedace within the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Upper Fossil Creek	1	Good
Average	**1.0**	**Good**

Narrow-headed gartersnake *(Thamnophis rufipunctatus)* and Proposed Critical Habitat

Status: Designated as Threatened on July 8, 2014 (USDI 2014c). Critical Habitat was proposed on July 10, 2013 (USDI 2013).

Historical range of the narrow-headed gartersnake (NHG) included perennial drainages across the Mogollon Rim from northern and eastern Arizona, southeast into southwestern New Mexico.

The species is strongly associated with clear, rocky streams using predominately pool and riffle habitat that includes cobbles and boulders. Narrow-headed gartersnakes specialize on fish as their primary prey, feeding almost exclusively on native or soft-rayed fish. They are ambush predators that often anchor to stream cobbles and wait for fish to pass. They bask on nearby rocks, boulders and vegetation and seek cover in crevices and beneath rocks. Brumation occurs during fall and winter in rocky outcroppings above the high water mark, usually within 0.5 mi of the stream. Threats to this species include harmful nonnative species, destruction and modification of habitat and effects from wildfire on their prey base. Additional information for the narrow-headed gartersnake can be found at: https://www.fws.gov/southwest/es/arizona/N-HGartersnake.htm

Habitat in the Analysis Area

Proposed critical habitat occurs within the project area in Canyon, Carrizo, and Tonto creeks (Table 17). USFWS considers all proposed critical habitat as occupied.

Table 17. Narrow-headed gartersnake proposed Critical Habitat acres by stream and 6th Code subwatershed (HUCs) within the Rim Country proposed project area.

Streams within Unit	6th Code HUC subwatershed	Acres within Project area
Canyon Creek		**1153.4**
	Canyon Creek Headwaters	1153.4
Carrizo Creek		**174.3**
	Bear Canyon – Black Canyon	0.66
	Buckskin Canyon – Carrizo Creek	173.6
Tonto Creek		**1488.9**

Streams within Unit	6th Code HUC subwatershed	Acres within Project area
	Bull Tank Canyon – Tonto Creek	1479.2
	Christopher Creek	9.70
	Horton Creek – Tonto Creek	1068.2

Six watersheds (6th HUCs) contain Narrow-headed gartersnake streams within the project area. Riparian condition within these watersheds ranges from Functioning at Risk (n=3) to Impaired (n=3) (Table 18). The average riparian condition for Narrow-headed gartersnake watersheds is 2.5, which equates to Functioning at Risk.

Table 18. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Narrow-headed gartersnake within the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Bear Canyon-Black Canyon	3	Poor
Buckskin Canyon-Carrizo Creek	2	Fair
Bull Tank Canyon-Tonto Creek	3	Poor
Canyon Creek Headwaters	2	Fair
Christopher Creek	3	Poor
Horton Creek-Tonto Creek	2	Fair
Average	**2.5**	**Poor**

Northern Mexican gartersnake *(Thamnophis eques megalops)* and Proposed Critical Habitat

Status: Designated as Threatened on July 8, 2014 (USDI 2014c). Critical Habitat was proposed on July 10, 2013 (USDI 2013).

The natural history of the northern Mexican gartersnake is detailed in the Final Rule to list the species as threatened (USDI 2014c) and is incorporated by reference in this report. The northern Mexican gartersnake (NMG) is generally found in riparian areas when not engaged in dispersal, gestation, or brumation behaviors. It is also often found in streams, rivers, cienegas, stock tanks, ephemeral pools, and spring sources within large-river riparian woodlands, forests, streamside gallery forests, and grasslands.

Historically, the northern Mexican gartersnake occurred within major watersheds in Arizona, as well as in the Gila and San Francisco watersheds in New Mexico. The current range of the snake in New Mexico still includes the Gila River. The snake's range in Arizona has been reduced to the following specific locations: the Bill Williams River, Agua Fria River, the upper Salt River subbasin, Tonto Creek, the Verde River subbasin, the upper Santa Cruz River subbasin, Redrock Canyon, the Buenos Aires National Wildlife Refuge, the Cienega Creek subbasin, the San Pedro River subbasin, the Babocomari River subbasin, and the San Bernardino National Wildlife Refuge. Approximately 83 percent of the population throughout its range is estimated to be at low-enough densities that the populations are not likely viable.

Threats to the species include predation by nonnative aquatic species (e.g., warm water sportfish, bullfrogs, and crayfish); reduction or removal of its prey base; natural or anthropogenic dewatering of aquatic habitat; indirect effects from fisheries management activities; road construction, use, and maintenance; adverse interactions with humans; livestock grazing in the presence of harmful nonnative species; and, to a lesser extent, ash flows from wildfires that remove the prey base or habitat for prey

species. Further information on this species can be found at:
https://www.fws.gov/southwest/es/arizona/MexGartersnake.htm

Proposed critical habitat for the northern Mexican gartersnake was published in 2013 (U.S. Fish and Wildlife Service 2013e); this information is incorporated by reference in this BA. In total, 421,423 acres is proposed as critical habitat in the various river basins and areas throughout New Mexico and Arizona. Fourteen individual critical habitat units are proposed: upper Gila River, Mule Creek, Bill Williams River, Agua Fria River, upper Salt River, Tonto Creek, Verde River, upper Santa Cruz River, Redrock Canyon, Buenos Aires National Wildlife Refuge, Cienega Creek, San Pedro River, Babocomari River, and San Bernardino National Wildlife Refuge.

Habitat in the Analysis Area

Approximately 1,465 acres of proposed critical habitat occurs within the project area in Tonto Creek (Table 19). USFWS considers all proposed critical habitat as occupied.

Table 19. Northern Mexican gartersnake proposed Critical Habitat acres by stream and 6th Code subwatershed (HUCs) within the Rim Country proposed project area.

Streams within Unit	6th Code HUC subwatershed	Acres within Project area
Tonto Creek		**1465.3**
	Bull Tank Canyon-Tonto Creek	401.1
	Christopher Creek	9.7
	Horton Creek-Tonto Creek	1054.5

Three watersheds (6th HUCs) contain Northern Mexican gartersnake streams within the project area. Riparian condition within these watersheds ranges from Functioning at Risk (n=1) to Impaired (n=2) (Table 20). The average riparian condition for Northern Mexican gartersnake watersheds is 2.7, which equates to Impaired.

Table 20. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Northern Mexican gartersnake within the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Bull Tank Canyon-Tonto Creek	3	Poor
Christopher Creek	3	Poor
Horton Creek-Tonto Creek	2	Fair
Average	**2.7**	**Poor**

Sensitive Species Analyzed in Detail

Narrow-headed gartersnake *(Thamnophis rufipunctatus)*

For information regarding this species' biology, habitat, historical range, species status reviews, and presence in the action area refer to Affected Environment: Threatened and Endangered Species Analyzed in Detail above.

Northern Mexican gartersnake *(Thamnophis eques megalops)*

For information regarding this species' biology, habitat, historical range, species status reviews, and presence in the action area refer to Affected Environment: Threatened and Endangered Species Analyzed in Detail above.

Desert sucker *(Pantosteus clarki)*

The desert sucker (*C. clarki*), also known as the Gila mountain-sucker, is a moderate-sized member of the sucker family (Catostomidae), reaching lengths of up to 12 inches. Its mouth is ventral with large lips, and has well-developed cartilaginous scraping edges on the jaws. The coloration is silvery tan to dark greenish above, silvery to yellowish below. During spawning, both sexes may display an orange red lateral stripe.

Desert sucker occurs in the Bill Williams, Salt, Gila, San Francisco, and Verde River drainages in Arizona and New Mexico. It is characteristic of small to moderately large streams, at elevations of about 1,000 to 6,000 feet. Desert sucker does not occur in reservoirs, and dams and diversions of free-flowing streams have diminished its range somewhat. The species is generally common throughout its range, however continuing threats of water development make its future uncertain. This report will analyze effects to desert sucker and its habitat, as it is present in Oak Creek and Sycamore Creek.

Desert sucker is found in rapids and flowing pools of streams, primarily over bottoms of gravel-rubble with sandy silt in the interstices (AGFD 2002a). Adults live in pools, moving at night to swift riffles and runs, where they feed on encrusting algae scraped from stones. Young inhabit riffles throughout the day, feeding on midge larvae. Individuals exhibit little seasonal movement, and resist downstream displacement during floods. The desert sucker is highly adaptive to a wide range of temperatures, tolerating water temperatures as high as 90°F. It may be able to tolerate lower oxygen levels than other native stream fishes.

Chironomid larvae (midges) are the primary food of juveniles (AGFD 2002a). As an adult, the desert sucker is primarily herbivorous, scraping filamentous algae from stones as well as ingesting plant detritus, aquatic insect larvae, and other invertebrates. Individuals often turn completely upside-down as they glean food off surfaces of stones.

Desert suckers spawn in late winter or early spring on riffles, where adults congregate in large numbers. Spawning typically occurs with one larger female and two or more smaller males. Lateral movements of the female's body form a depression in the stream channel substrates, and adhesive eggs are buried in loose gravels. Eggs hatch in a few days, and larvae gather in quiet pools near the bank, moving to swifter waters as they mature. Juveniles are mature by the second year of life at a length of 4 to 5 inches. More information on desert sucker can be found at:
https://www.fws.gov/southwest/es/arizona/Desert_Sucker.htm

Habitat in the Analysis Area

Desert sucker occurs in approximately 106 miles of streams within the proposed project area (Table 21). These eighteen streams are either currently occupied or provide suitable habitat for the species.

Table 21. Miles of occupied or suitable habitat for desert sucker by stream and 6th Code subwatershed (HUCs) within the Rim Country proposed project area.

Stream	6th HUC subwatershed	Miles in Project Area
Bear Canyon		**2.9**
	Upper West Clear Creek	2.9
Buzzard Roost Creek		**2.2**
	Buzzard Roost Canyon	2.2
	Rock Creek	0.0
Canyon Creek		**5.9**
	Canyon Creek Headwaters	5.9
Cherry Creek		**0.7**
	Gruwell Canyon-Cherry Creek	0.7
Christopher Creek		**7.5**
	Christopher Creek	7.5
Dane Canyon		**9.2**
	Barbershop Canyon	9.2
East Bear Canyon		**2.7**
	Bear Canyon	2.7
East Clear Creek		**13.3**
	East Clear Creek-Clear Creek	13.3
	Leonard Canyon	0.0
Gordon Creek		**4.5**
	Gordon Canyon	4.5
Haigler Creek		**8.9**
	Haigler Creek	8.9
Hunter Creek		**2.6**
	Christopher Creek	2.6
Miller Canyon		**13.2**
	East Clear Creek-Blue Ridge Reservoir	0.0
	Miller Canyon	13.2
Mule Creek		**2.1**
	Canyon Creek Headwaters	2.1
Pine Creek		**8.5**
	Pine Creek	8.5
Rock Creek-Salt		**4.5**
	Rock Creek	4.5
Tonto Creek		**8.7**
	Bull Tank Canyon-Tonto Creek	3.1
	Christopher Creek	0.0
	Horton Creek-Tonto Creek	5.5
Turkey Creek		**2.1**
	Rock Creek	2.1
Webber Creek		**6.5**
	Webber Creek	6.5
Grand Total		**106.1**

Eighteen watersheds (6th HUCs) contain Desert sucker streams within the project area. Riparian condition within these watersheds ranges from Functioning at Risk (n=8) to Impaired (n=10) (Table 22). The average riparian condition for Desert sucker watersheds is 2.6, which equates to Impaired.

Table 22. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Desert sucker the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Barbershop Canyon	3	Poor
Bear Canyon	3	Poor
Bull Tank Canyon-Tonto Creek	3	Poor
Buzzard Roost Canyon	2	Fair
Canyon Creek Headwaters	2	Fair
Christopher Creek	3	Poor
East Clear Creek-Blue Ridge Reservoir	3	Poor
East Clear Creek-Clear Creek	2	Fair
Gordon Canyon	3	Poor
Gruwell Canyon-Cherry Creek	3	Poor
Haigler Creek	2	Fair
Horton Creek-Tonto Creek	2	Fair
Leonard Canyon	3	Poor
Miller Canyon	3	Poor
Pine Creek	3	Poor
Rock Creek-Spring Creek	2	Fair
Upper West Clear Creek	2	Fair
Webber Creek	2	Fair
Average	**2.6**	**Poor**

Sonoran sucker *(Catostomus insignus)*

Sonora sucker (*C. insignis*), also known as the Gila sucker, is a large, robust member of the sucker family (Catostomidae), commonly reaching lengths between 12 and 24 inches. Its mouth is ventral with large fleshy lips. The body is sharply bi-colored, brownish dorsally and yellow beneath. During breeding season, males develop large nuptial tubercles on their anal and caudal fins, and on the lower, posterior part of the body.

Sonora sucker is widely distributed and 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. It is uncommon in the upper Santa Cruz River in Arizona. Except in Aravaipa Creek, it has been extirpated from the San Pedro River in southern Arizona and northern Sonora, Mexico. The species is intolerant of reservoir conditions (Minckley 1973). Dams and diversions of free-flowing streams, water pollution, and sedimentation of streams have diminished its range, and the status of the species is uncertain. This report will analyze effects to Sonora sucker and its habitat, as it is present in Oak Creek and Sycamore Creek.

Sonora sucker is characteristic of gravelly or rocky pools of creeks and rivers. It can be found in a variety of habitats from warm water rivers to trout streams. Adults tend to remain near cover in daylight, but move to runs and deeper riffles at night. Young Sonora sucker typically live in runs and quiet eddies. Individuals are sedentary, exhibiting little seasonal movement and resisting downstream displacement during floods. Information on temperature tolerances or other habitat preferences has not been obtained.

Foods appear to vary with availability. In Aravaipa Creek it is almost exclusively a carnivore, feeding upon the abundant aquatic insect larvae (primarily mayflies) of that stream. In other places, especially where large populations are concentrated in pools in summer, intestines are filled with plant debris, mud,

or algae. Seeds of cottonwood trees are taken seasonally. Young feed along the margins of streams upon tiny crustaceans, protozoans, and other animal and plant groups (Minckley 1973).

Spawning begins in February and extends until July. Eggs are deposited in riffles, and fall into the interstices between gravel particles where they incubate. Larval fish appear within a few days. Areas where suckers have been spawning may often be identified as elongated patches of "cleaned" gravel on riffles, marking the places where algae-covered bottom materials have been shifted about. Spawning does not appear correlated with any specific pattern of stream flow or temperature. Information on age and growth has not been developed. Further information on this species can be found at: https://www.fws.gov/southwest/es/arizona/Sonora_Sucker.htm

Habitat in the Analysis Area

Sonoran sucker occurs in approximately 13.1 miles of streams within the proposed project area (Table 23). The three streams (Canyon Creek, East Verde River, and Tonto Creek) are either currently occupied by the species or provide suitable habitat.

Table 23. Miles of occupied or suitable habitat for Sonoran sucker by stream and 6th Code subwatershed (HUCs) within the Rim Country proposed project area.

Stream	6th HUC subwatershed	Miles in Project Area
Canyon Creek	Canyon Creek Headwaters	5.9
East Verde River	East Verde River Headwaters	7.1
Tonto Creek	Bull Tank Canyon – Tonto Creek	0.2
Total		**13.1**

Three watersheds (6th HUCs) contain Sonoran sucker streams within the project area. Riparian condition within these watersheds ranges from Functioning at Risk (n=1) to Impaired (n=2) (Table 24). The average riparian condition for Sonoran sucker watersheds is 2.7, which equates to Impaired.

Table 24. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Sonoran sucker the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Bull Tank Canyon-Tonto Creek	3	Poor
Canyon Creek Headwaters	2	Fair
East Verde River Headwaters	3	Poor
Average	**2.7**	**Poor**

Little Colorado sucker *(Catostomus sp. 3)*

This species is similar to flannelmouth sucker and is endemic to the upper portion of the Little Colorado River and many of its north flowing tributaries at elevations from 2,200 to 7,100 ft. (Minckley 1973). It has also been introduced into the Salt River. It occurs in creeks, small to medium rivers, and impoundments. Predominantly found in pools with abundant cover, and also in riffles. Foods consist of detritus, algae, and aquatic invertebrates. Reduction in distribution is thought to be a result of habitat loss due to stream flows, water diversions, dam construction, channel and watershed erosion, and interactions with non-native fish species.

Habitat in the Analysis Area

Little Colorado sucker occurs in approximately 147 miles of streams within the project area (Table 25). The eight streams are either currently occupied by the species or provide suitable habitat within the Little Colorado drainage.

Table 25. Miles of occupied or suitable habitat for Little Colorado sucker by stream and 6th Code subwatershed (HUCs) within the Rim Country proposed project area.

Streams	6th HUC subwatershed	Miles in Project Area
Barbershop Canyon		**14.7**
	Barbershop Canyon	14.7
	East Clear Creek-Clear Creek	0.0
Bear Canyon		**6.6**
	Bear Canyon	6.6
Chevelon Creek		**22.6**
	Durfee Draw-Chevelon Canyon	7.8
	Long Tom Canyon-Chevelon Canyon	7.8
	Upper Chevelon Canyon-Chevelon Canyon Lake	7.0
East Clear Creek		**38.4**
	East Clear Creek-Blue Ridge Reservoir	18.4
	East Clear Creek-Clear Creek	19.9
	Leonard Canyon	0.0
	Miller Canyon	0.0
Leonard Canyon		**20.6**
	Leonard Canyon	20.6
Miller Canyon		**13.2**
	Miller Canyon	13.2
West Leonard Canyon		**8.5**
	Leonard Canyon	8.5
Willow Creek		**22.5**
	East Clear Creek-Clear Creek	0.0
	Gentry Canyon	0.0
	Lower Willow Creek	13.3
	Upper Willow Creek	9.2
Grand Total		**147.1**

Fourteen watersheds (6th HUCs) contain Little Colorado sucker streams within the project area. Riparian condition within these watersheds ranges from Functioning Properly (n=3) to Impaired (n=8) (Table26). The average riparian condition for Little Colorado sucker watersheds is 2.3, which equates to Functioning at Risk.

Table 26. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Little Colorado sucker the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Barbershop Canyon	3	Poor
Bear Canyon	3	Poor
Durfee Draw-Chevelon Canyon	1	Good
East Clear Creek-Blue Ridge Reservoir	3	Poor

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
East Clear Creek-Clear Creek	2	Fair
Gentry Canyon-Upper Clear Creek	3	Poor
Leonard Canyon	3	Poor
Long Tom Canyon-Chevelon Canyon	1	Good
Lower Willow Creek	2	Fair
Miller Canyon	3	Poor
Pine Creek	1	Good
Rock Creek-Spring Creek	2	Fair
Upper West Clear Creek	3	Poor
Webber Creek	3	Poor
Average	**2.3**	**Fair**

Headwater chub (*Gila nigra*)

Life history, distribution, status of the species range-wide and listing factors are found in documents located on the FWS website: http://www.fws.gov/southwest/es/arizona/Headwater_Chub.htm . An account of the taxonomy, biology, and reproductive characteristics of this species is found in the 2015 Federal Register designating a threatened DPS species status and the Species Status Assessment (USFWS 2015). All these documents are incorporated by reference into this document.

Headwater chubs occupy middle to headwater reaches of medium- sized streams of the Gila River Basin at elevations of 3,035 to 6,651 ft. They are usually found in large pools and associated with cover such as undercut banks, large pools, or deep places created by obstructions such as trees or rocks. Typical adult microhabitat consists of deep, nearshore pools adjacent to swifter riffles and runs. Headwater chub life span is 8-10 years and they can grow rapidly but growth is dependent on water temperature.

Headwater chub inhabit mid-sized headwater streams with warm or cool water in the Gila River Basin and have been documented between 4,000 to 6,500 feet. Maximum water temperatures where chubs were observed were 20- 26° C (68- 74°F) which suggests temperature is a limiting factor for distribution of chub species (Bestgen & Propst, 1989). Habitat requirements for adults are deep pools near shorelines and swift riffles, associated with a structure (downed logs or boulders) within pools, undercut banks, overhanging cliff walls, root wads and other types of cover while juveniles prefer relatively shallow, slower moving water with overhead cover and sand substrates. Headwater chub are omnivorous and like the roundtail chub, are known to feed on vegetation, detritus, terrestrial and aquatic insects, and fish (AZGFD, 2010).

Historical distribution of headwater chub is poorly understood because this species was only recently designated as *Gila nigra* in 2000 (Minckely & DeMarais, 2000). The headwater chub is believed to be a hybrid species from the interbreeding of the roundtail chub *Gila robusta* and the Gila chub *Gila intermedia* (AZGFD, 2006). This species was likely distributed throughout the Gila River Basin but likely did not have an extensive range. Recent studies pertaining to the headwater chub indicate that this species is declining across its entire range. Currently, headwater chub only occupy 40 percent of their historic range and today, only exist in four separate drainage basins: the Verde River, San Carlos, Tonto Creek, and upper Gila River Basins (USFWS, 2006).

Threats to headwater chub include a combination of habitat loss and degradation related to dams, diversions, groundwater pumping, mining, recreation, and livestock grazing, and competition and predation from non-native fish.

Habitat in the Analysis Area

Headwater chub occur in approximately 47.8 miles of streams within the project area (Table 27). The nine streams are either currently occupied by the species or provide suitable habitat.

Table 27. Miles of occupied or suitable habitat for headwater chub by stream and 6th Code subwatershed (HUCs) within the Rim Country proposed project area.

Streams	6th HUC subwatershed	Miles in Project Area
Buzzard Roost Canyon		**2.2**
	Buzzard Roost Canyon	2.2
	Rock Creek	0.0
East Verde River		**1.7**
	East Verde River Headwaters	1.7
Gordon Creek		**4.5**
	Gordon Canyon	4.5
Haigler Creek		**8.8**
	Haigler Creek	8.8
Pine Creek		**8.5**
	Pine Creek	8.5
Rock Creek		**4.8**
	Rock Creek	4.8
Turkey Creek		**2.1**
	Rock Creek	2.1
Upper Tonto Creek		**8.8**
	Bull Tank Canyon-Tonto Creek	3.1
	Horton Creek-Tonto Creek	5.7
Webber Creek		**6.5**
	Webber Creek	6.5
Grand Total		**47.8**

Nine watersheds (6th HUCs) contain Headwater chub streams within the project area. Riparian condition within these watersheds ranges from Functioning at Risk (n=5) to Impaired (n=4) (Table 28). The average riparian condition for Headwater chub watersheds is 2.4, which equates to Functioning at Risk.

Table 28. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Headwater chub the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Bull Tank Canyon-Tonto Creek	3	Poor
Buzzard Roost Canyon	2	Fair
East Verde Headwaters	3	Poor
Gordon Canyon	3	Poor

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Haigler Creek	2	Fair
Horton Creek-Tonto Creek	2	Fair
Pine Creek	3	Poor
Rock Creek-East Verde River	2	Fair
Webber Creek	2	Fair
Average	**2.4**	**Fair**

Roundtail chub (*Gila robusta*)

Roundtail chub utilize slow moving, deep pools for cover and feeding. They are found in the main stems of major rivers and smaller tributary streams. Roundtail chub utilize a variety of substrate types (silt, sand, gravel, and rocks) and prefer murky water to clear. Habitat use varies by life stages (adult, juvenile, and young-of-year). Juveniles and young-of-year are found in quiet water near the shore or backwaters with low velocity and frequent pools rather than glides and riffles. Juveniles use instream boulders for cover, while young-of-year are found in gaps between and under boulders or the slack-water area behind boulders. Adults generally do not frequent vegetation and avoid shallow water cover types, such as overhanging and shoreline vegetation. Adults are found in eddies and pools adjacent to strong current and use instream boulders as cover. Roundtail chub are carnivorous and opportunistic feeders, and food items include aquatic and terrestrial insects, fish, snails, crustaceans, and algae.

Threats to the roundtail chub include habitat alteration and degradation from water diversions, groundwater pumping, dewatering, mining, contaminants, urban and agricultural development, livestock grazing, and predation and competition by non-native aquatic species. Further information on this species can be found at: https://www.fws.gov/southwest/es/arizona/Roundtail.htm

Habitat in the Analysis Area

The five streams are either currently occupied by the species or provide suitable habitat.

Table 29. Miles of occupied or suitable habitat for roundtail chub by stream and 6th Code subwatershed (HUCs) within the Rim Country proposed project area.

Stream	6th HUC **subwatershed**	Miles
Canyon Creek		**5.4**
	Canyon Creek Headwaters	5.4
Cherry Creek		**0.8**
	Gruwell Canyon-Cherry Creek	0.8
Chevelon Creek		**7.7**
	Durfee Draw-Chevelon Canyon	7.7
	Upper Chevelon Canyon-Chevelon Canyon Lake	0.0
East Clear Creek		**19.5**
	East Clear Creek-Clear Creek	18.0
	Echinique Draw-Clear Creek	1.5
	Leonard Canyon	0.0
	Wilkins Canyon	0.0
Salome Creek	Upper Salome Creek	**0.9**
		0.9
Grand Total		**34.4**

Nine watersheds (6th HUCs) contain Roundtail chub streams within the project area. Riparian condition within these watersheds ranges from Functioning Properly (n=3) to Impaired (n=3); the remaining watersheds are Functioning at Risk (Table X). The average riparian condition for Roundtail chub watersheds is 2.0, which equates to Functioning at Risk.

Table 30. Riparian condition scores from Watershed Condition Framework for 6th Code HUCs with Roundtail chub the Rim Country proposed project area.

Occupied 6th HUCs	WCATT Riparian Condition Score	Associated Rating
Canyon Creek Headwaters	2	Fair
Durfee Draw-Chevelon Canyon	1	Good
East Clear Creek-Clear Creek	2	Fair
Echinique Draw-Clear Creek	1	Good
Gruwell Canyon-Cherry Creek	3	Poor
Leonard Canyon	3	Poor
Upper Chevelon Canyon-Chevelon Canyon Lake	1	Good
Upper Salome Creek	2	Fair
Wilkins Canyon	3	Poor
Average	**2.0**	

A Net-winged midge *(Agathon arizonicus)*

This species requires swift-moving streams, typically with waterfalls, that supports its larvae. Adults do not leave the riparian corridor. The species is currently known only from Workman Creek in the Sierra Ancha Mountains. Little information exists on the species, but suitable habitat exists.

A stonefly *(Capnia caryi)*

The newly described species is found in only two high elevation locations in the southern Rocky Mountains of New Mexico and Arizona (Baumann and Jacobi, 2002). It was found in two tiny creeks where substrate consisted of scattered boulders and a mixture of cobble with gravels. The gradient was 3% and the water was clear and cool, with low amounts of dissolved materials (Baumann and Jacobi, 2002).

In New Mexico, it has been recorded from New Mexico in Catron Co. (Upper Iron Creek) and Arizona in Apache County (Mamie Creek at Escudilla Mountain); both near the border of southern Arizona and New Mexico (Baumann and Jacobi, 2002). Little information exists on the species, but suitable habitat exists.

Parker's cylloepus riffle beetle (*Cylloepus parkeri*)

This species is associated with perennial, flowing streams. It is associated with stream riffles and is only known from two creeks in Bloody Basin (TNF 2015). Little information exists on the species, but suitable habitat exists.

A Mayfly (*Fallceon eatoni*)

Originally collected in 1892 from northern Sonora, Mexico (USFWS 2010). The species had not been recorded since then until a single specimen was identified from collections in 2005 from Salt River Canyon, Gila Co., Arizona (NatureServe). Another occurrence was recently reported from Cottonwood

Canyon in the San Bernardino Mountains in Riverside Country, California. Little information exists on the species, but suitable habitat exists.

A Mayfly *(Moribaetis mimbresaurus*)

This is one of six species of the genus in North and South America, and the only member north of Mexico. The species is only known from a single locality in the Salt River Canyon in Gila County as well as Pumphouse Wash in Oak Creek. It is associated with perennial and ephemeral streams as well as springs associated with Cottonwood Willow Riparian Forest and Mixed Broadleaf Riparian Forest given mayflies have a strictly aquatic larval stage (McCafferty 2006). Little information exists on the species, but suitable habitat exists.

A caddisfly (*Lepidostoma apache*)

Limited information is known about this recently described species. It is found in freshwater habitat, but the larval habitat is unknown. It has only been found in the Blue River, on the ASNF (Houghton, 2001b). Little information exists on the species, but suitable habitat exists.

A caddisfly (*Lepidostoma knulli*)

This is a medium-sized caddisfly of the diverse Lepidostoma family, endemic to higher elevation southwestern United States watersheds ranging from 4500 to 8530 feet in elevation. It occurs in cool stream segments with swift flowing water, dominated by large cobbles with low embeddedness of interstitial gravels (Blinn and Ruiter 2009). Threats to the species include limited distribution or endemism in addition to threats to ecosystem or aquatic diversity. It is associated with Mixed Broadleaf Riparian Forest or Cottonwood Willow Riparian Forest.

This species is uncommon in Arizona, Montana, New Mexico, and Mexico. It has been found in eastern Arizona in two sites on the ASNFs and in Pumphouse wash and Indian Gardens in Oak Creek Canyon on the COC. It has been listed in sites in Apache and Coconino County Arizona. Little information exists on the species, but suitable habitat exists.

A caddisfly *(Limnephilus granti)*

The species is extremely rare. All specimens have been collected from springs and their immediate outlets in the ponderosa pine region of eastern Arizona. It is known only from the type specimen and a few additional specimens found in Grant Creek in Graham County, Government Spring, south of Greer in Apache County, and Rosey Creek, near Greer also in Apache County (Blinn and Ruiter, 2009). Little information exists on the species, but suitable habitat exists within the project area.

Ferris' copper butterfly *(Lycaena ferrisi)*

The species is the only one in its range that resembles the Ruddy copper butterfly. Its host plant in the larval stage is Arizona dock (also known as wild rhubarb) (*Rumex hymenosepalus*), while the adult feeds on nectar including that of yellow composites. Its primary habitat is open meadows and cienegas springs. Threats include fire suppression because it results in the invasion of meadow habitats by dense conifer forests and an understory of grasses (USFWS 2009).

This species has a very limited distribution, and is known only in the White Mountains of eastern Arizona. It is known to occur in the White Mountains of Apache County, near McNary and Maverick, and in Greer County, Arizona (USFWS 2009). It is critically imperiled globally and in Arizona. There may be only a single metapopulation, and there may be less than 20. Little information exists on the species, but suitable habitat exists.

Nokomis Fritillary (aka Great Basin Silverspot) *(Speyeria nokomis nokomis)*

This species is associated with permanent spring-fed meadows, seeps, marshes, and boggy streamside meadows with flowing water in arid country. Presence of its larval foodplant (bog violet [*Viola nephrophylla*]) is a critical habitat component. The species is only known from Apache Country, Arizona. There was a recently confirmed locality in Gila County. Little information exists on the species, but suitable habitat exists.

California Floater (*Anodonta californiensis*)

This mussel prefers shallow areas of clean, clear lakes, ponds and large rivers. It prefers lower elevations and soft, silty substrate to burrow into. The life cycle of California floater includes a parasitic larval stage during which it is dependent upon a host fish, usually a member of the Gila genus, for food and dispersal. The adult and juvenile phases are sedentary, filter-feeders. It is associated with perennial springs and streams in every riparian forest type. There are no occupied locations within the proposed project area, but suitable habitat does exist.

Distribution used to range from southern British Columbia south to northern Baja California, and east to Wisconsin. Today, numbers have been depleted to the point that it is extinct throughout much of its former range, including Utah, the entire Sacramento River system, and most of Arizona. Specimens have been found in Chevelon Creek, East Clear Creek near the confluence of Leonard Canyon, and Show Low Creek. It is believed to have been present historically within the proposed project area in the Beaver Creek, Cherry Creek-Verde River, Fossil Creek-Verde River, Lower Clear Creek, Upper Chevelon Canyon, Upper Clear Creek, and West Clear Creek 5th HUC watersheds. There are presently no known extant populations within the proposed project area.

Summary of Alternatives

Alternative 1 – No Action

The No Action alternative is required by 40 CFR 1502.14(c). It represents no changes to current management, and current forest plans would continue to be implemented. Ongoing vegetation treatments and fire management activities, as well as road maintenance, recreation, firewood gathering, authorized livestock grazing, and other activities already authorized in separate NEPA decisions would continue. There would be no other restoration activities approved with the Rim Country Project. The potential direct, indirect, and cumulative effects from no action will be analyzed. The no action alternative is the baseline for assessing the action alternatives (Alternatives 2 and 3).

Action Alternatives

The restoration activities listed for the action alternatives includes vegetation treatments (mechanical thinning and prescribed burning) as part of several restoration treatments described below (Table 31). Associated actions that are needed to implement vegetation treatments includes: In Woods Processing Sites, use/expansion of rock pits, and use of ML-1 roads. The action alternatives also includes comprehensive restoration activities such as stream, riparian, wetland, grassland and spring restoration as well as road decommissioning and relocation.

Vegetation treatments include a variety of methods such as mechanical harvest, mastication, grinding, chipping, and hand thinning. Methods to be implemented are dependent upon site conditions, design features, topography, and type of treatment. Equipment that may be utilized includes, but is not limited to, ground-based or cable-logging systems of various kinds, chainsaws, chippers, grinders, masticators, and

mulchers. Vegetation treatments will be implemented using the Flexible Toolbox Approach for Mechanical Treatments. While vegetation treatment types described below differ in the level of their ground disturbance and inherent impacts to aquatic habitat and species, the analysis will address the highest level of disturbance (mechanical harvest).

General Vegetation Treatments: Silvicultural treatments to improve forest density, structure and composition. Mechanical vegetation treatments will also include associated actions such as machine or hand piling as well as lop and scatter of slash material.

Facultative Operations: Mechanical treatment non-target cover types (e.g. juniper) using ground based logging systems or hand thinning as well as prescribed burning on non-target cover types to support treatments in target cover types. This treatment also includes associated actions such as machine or hand piling as well as lop and scatter of slash material.

Aspen Restoration: Mechanically remove non-aspen species with ground-based logging systems within 66 feet (one chain) of an aspen clone to promote growth. This treatment also includes associated actions such as machine or hand piling as well as lop and scatter of slash material. Installation of fencing will also likely be necessary.

Severe Disturbance Treatment Areas: These areas represent a variety of post high-intensity fire conditions. Treatments include mechanical thinning and mastication of undesirable species such as juniper, thinning of pine in areas with an abundance of regeneration (ground-based logging systems), and reforestation (planting with site preparation) where inadequate regeneration occurs. Site preparation can range from Reforestation can be completed by hand or using machinery such as a gas-powered auger or skid steer with an auger attachment. Site preparation can include mechanical, prescribed burning, or mulching. This treatment also includes associated actions such as machine or hand piling as well as lop and scatter of slash material. Broadcast and pile burning are also included.

Savanna Restoration: Mechanical treatments to reduce encroachment to pre-settlement densities using ground based logging systems, hand thinning, and prescribed fire to restore and sustain these habitat types.

Grassland and Meadow Restoration: Mechanical vegetation treatments to remove conifer encroachment. Methods include ground based logging systems and hand thinning to restore and sustain these habitat types.

Riparian and Wet Meadow Restoration: Mechanical Vegetation and prescribed fire treatments to remove encroachment using ground base logging systems, hand thinning, and prescribed fire. Planting desirable riparian species may occur using methods ranging from planting by hand (e.g., dibble or hoedad) to a skid-steer with an auger.

Prescribed Fire Treatments: Prescribed burning is being analyzed as part of every mechanical vegetation treatment described above. Implementation could occur using both hand and aerial ignition as well as associated fireline needed to contain burn units. It includes broadcast burning as well as pile burning.

For the purposes of this analysis, mechanical vegetation management and prescribed burning are analyzed across the proposed restoration treatments rather than in the categories described above.

Road Use: Utilize and maintain approximately 5,682 miles of Forest system roads for implementation of all treatments. This includes, opening 2,076 miles of existing closed roads (ML-1) to utilize them for the

time period that they are needed to provide access for restoration work. These roads shall be closed upon completion of work in the area they access returned to a closed status (ML-1).

Road Decommissioning: Stabilize and restore approximately 1,290 miles of existing system roads and existing unauthorized routes to a more natural state. Methods include the full spectrum of decommissioning options from blocking the entrance, revegetation and water barring, removing fills and culverts, establishing drainage ways and removing unstable road shoulders, all the way to full obliteration (recontouring and restoring natural slopes).

Road Relocation: Relocate and reconstruct existing open roads adversely affecting water quality and natural resources, or of concern to human safety as outlined in the Rim Country Flexible Toolbox Approach for Aquatics and Watersheds.

Temporary Road Construction/Decommission: Construct or improvement of new temporary roads or existing non-system roads to facilitate all proposed treatments; decommission all temporary roads when treatments are completed.

Rock Pits: The use, including potential expansion, of 12 individual rock pits totaling approximately 131 acres on the Apache-Sitgreaves National Forests. The removal and transportation and of the rock pit materials will be used for improvement and maintenance of roads for specific projects that utilize maintenance level 1 (closed roads, for administrative use only), maintenance level 2 roads (maintained for high-clearance vehicles). In addition the rock material could be used for construction and maintenance of temporary roads.

In Woods Processing Sites: Construction of 13 wood processing sites, totaling approximately 142 acres. Tasks carried out at processing sites includes drying, debarking, chipping stems and bark, cutting logs, manufacturing and sorting logs to size, scaling and weighing logs and creating poles from suitable sized logs. Equipment types commonly used at processing sites include circular or band saws, various sizes and types of front-end loaders, log loaders and chippers of several types and may include timber processors, planers and mechanized cut to length systems, associated conveyers and log sorting bunks for accumulation and storage of logs. Electric motors and gas or diesel generators are also used to provide power.

Stream Restoration: Restore function and aquatic habitat in up to 777 miles of streams. In addition, approximately 200 miles of protective barriers around springs, aspen, native willows, and big-tooth maples, as needed for restoration objectives. Methods for stream restoration vary and specific treatments will be determined prior to implementation. The Aquatic and Watershed Flexible Toolbox Approach (AWFTA) outlines the potential treatments that are being analyzed (Appendix C).

Spring Restoration: Restore approximately 184 springs as outlined in the Aquatic and Watershed Flexible Toolbox Approach (AWFTA).

Table 31. Summary of Alternatives 2 and 3 Treatments as analyzed for aquatic resources.

Treatment	Alternative 2 acres/miles	Alternative 3 acres/miles
Mechanical Vegetation Treatments	889,344 acres	486,157 acres
Prescribed Burning	953,132 acres	529, 059 acres
Miles of Open ML-1 Roads	2,076 miles	2,076 miles
Road Decommissioning	1,290 miles	1,290 miles

Treatment	Alternative 2 acres/miles	Alternative 3 acres/miles
Temporary Roads Used	300 miles	170 miles
Rock Pits	131 acres	131 acres
In Woods Processing Sites	142 acres	142 acres
Stream Restoration	777 miles	777 miles
Total	**950,116**	

Alternative 2 is the Proposed Action as presented for scoping, with changes in response to public comments received. It is designed to implement restoration treatments across the entire project area. This alternative responds to the Dwarf Mistletoe Mitigation issue through the use of regular restoration treatments that focus on dwarf mistletoe infections.

Alternative 3 is designed to focus proposed treatments in areas that are the most highly departed from the natural range of variation (NRV) of ecological conditions, and/or that put communities at risk from undesirable fire behavior and effects. High value assets will be better protected and burn boundaries will be designed to create conditions safe for personnel and to ensure fire can meet objectives. Treatment areas would be chosen to optimize ecological restoration, those areas that are most important to treat and can be moved the furthest toward desired conditions. Focusing on the higher priority ecological restoration will result in fewer acres being treated. The proposed treatments in Alternative 3 will be used to address moderate and high levels of mistletoe infection, but to a lesser extent on the fewer acres proposed for mechanical treatment and fire. The presence of dwarf mistletoe will not be used to prioritize areas for treatment, but it will be addressed where it exists, using the same types of treatments as Alternative 2.

Alternative 2: Modified Proposed Action

- Largest extent of vegetation treatments (mechanical and prescribed fire).
- Moderate reduction in tree basal area across landscape
- Significant reduction in undesirable fire behavior & effects across landscape

Alternative 3: Focused Alternative

- Smallest extent of vegetation treatments (mechanical and prescribed fire).
- Moderate reduction in tree basal area where treated
- Reduction in undesirable fire behavior and fire effects near WUI and high value resources.

Project Design Features

This section summarizes project design features that are key to this analysis. These provide additional detail regarding how the various project activities (resource measures) will be implemented on the ground to minimize or reduce potential impacts to the resource indicators. Project design features are the same for both Alternatives 2 & 3.

Table 32. Design Features which reduce potential impacts, their relationship to resource indicators and what resource measures they are associated with.

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
AQ001	Any equipment or personnel for activities in and around streams, natural or constructed waters, springs, or wetlands of any kind will use decontamination procedures to prevent the spread of disease (e.g., Chytrid fungus) and aquatic invasive species. Personnel entering water bodies for any reason will also follow these procedures. This applies to entry into every aquatic restoration site and in between sites.	Reduces potential for introduction or spread of exotic or aquatic invasive species	Pollutants/ Exotic & Invasive species	All Measures
AQ006	Minimize the number and length of temporary road stream crossings. Such crossings will be at right angles and avoid potential spawning or breeding areas to the greatest extent possible. Stream crossings shall not increase the risk of channel re-routing at low and high water conditions. After project completion, temporary stream crossing will be abandoned and the stream channel and banks restored.	Reduces potential mortality Reduces changes in peak flows	Impacts to Individuals Riparian Condition	Miles of ML-1 Roads
AQ008	To the extent feasible, heavy equipment will work from the top of the bank, unless working from within the stream bed would result in less damage to the aquatic ecosystem, as determined by a biologist.	Reduces bank instability, erosion and sedimentation	Riparian Condition	Miles of Heavy Mechanical Stream Restoration
AQ014	Minimize removal of desirable vegetation around springs and wetlands.	Reduces sedimentation and loss of streamside vegetation	Riparian Condition	All Measures
AQ015	Minimize disturbance of existing vegetation in ditches and at stream crossings.	Reduces sedimentation	Riparian Condition	Miles of ML-1 Roads
AQ018	Structural erosion control measures will not include materials that can trap reptiles or amphibians. This requirement will be described in a standard contract provision BT6.6 (erosion prevention and control), BT6.67 (erosion control structure maintenance) and within the road package, or specified in any agreements as a provision. Structural erosion control measures not made of biodegradable material (e.g., silt fences) will be removed and material contoured in or removed within one year to prevent them from causing resource issues and decomposing on site.	Reduces potential mortality	Impacts to Individuals	Acres of Mechanical thinning, Miles of ML-1 Roads

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
AQ019	Given the potential for multiple aquatic species to occur in a given location, FS, FWS, and AGFD biologists will cooperatively prioritize aquatic species of concern on a site specific basis regarding timing restrictions for instream and riparian restoration activities. Work will occur during base-flow conditions, and on dry or frozen riparian soil conditions where possible.	Reduces potential mortality	Impacts to Individuals	Miles of Heavy Mechanical Stream Restoration
AQ020	Biologists will be consulted during pre-planning for all treatments that will occur in springs, streams, and riparian areas, as well as fens or bogs where histic soils are present, to determine presence of federally listed or sensitives species (plants or animals), as well as mitigations needed for rare or sensitive species in/near the work areas.	Reduces potential mortality	Impacts to Individuals	Miles of Heavy Mechanical Stream Restoration
AQ021	Gartersnakes: • Aquatic Management Zones in Narrow-headed and Northern Mexican Garter snake proposed critical habitat will be 600 ft. on either side of the stream. • No mechanical or hand piling will occur within the Garter snake AMZs to minimize effects to during controlled burns or pile burning. • Disturbance of rock/boulder piles and large woody debris in narrow-headed or northern Mexican garter snake habitat or proposed critical habitat will be avoided to the greatest extent practical during their hibernation period. • Do not build temporary roads in narrow-headed or northern Mexican garter snake habitat or proposed critical habitat during their hibernation period.	Reduces potential mortality	Impacts to Individuals	Acres of Mechanical Thinning, Acres of Prescribed Burning
AQ022	A qualified, permitted biologist will be on site during heavy equipment construction activities to attempt to protect narrow-headed or northern Mexican garter snakes and/or key habitat features during construction. This will occur within proposed critical habitat for construction zones in the following project types: • Fish Passage Restoration • Large Wood, Boulder, and Gravel Placement • Legacy structure removal or maintenance • Channel Reconstruction/Relocation • Off- and Side-Channel Habitat Restoration • Streambank Restoration • Set-back or Removal of existing berms for aquatic restoration • Beaver Habitat Restoration	Reduces potential mortality	Impacts to Individuals	Miles of Heavy Mechanical Stream Restoration

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
AQ023	Garter snakes: Any Narrow-headed and Northern Mexican garter snakes found will be relocated for the project types listed above following the Instream Construction Zone Isolation for Aquatic Species design features. Per the protocol, biologists will pre-identify areas where snakes would be moved in coordination with Arizona Game and Fish Department and U.S. Fish and Wildlife Service.	Reduces potential mortality	Impacts to Individuals	Miles of Heavy Mechanical Stream Restoration
AQ024	Instream Construction Zone Isolation from Aquatic Species: Isolate Capture Area within the construction zone • Install block nets at up and downstream locations outside of the construction zone to exclude fish from entering the project area. Leave nets secured to the stream channel bed and banks until construction activities within the stream channel are complete. Capture and release of species within the construction zone • Species trapped within the isolate work area will be captured and released as prudent to minimize risk of injury, then released at a safe release site, preferably upstream of the isolated reach, for fish in a pool or other area that provided cover and flow refuge Dewatering construction site • When dewatering is necessary, ensure diversion passes flows and aquatic species to minimize detrimental effects. Return flow to downstream channel so they are not dewatered. Coffer dams should be built with non-erosive materials or covered in a manner that minimizes erosion and sedimentation as well as decreases in water quality. Surface Water Withdrawals • Surface water may be diverted to meet construction needs, but only if developed sources are unavailable or inadequate. If aquatic species are or may be present (e.g. fish, tadpoles, and mollusks), diversions may not exceed 10% of the available flow and fish screen(s) will be installed, operated, and maintained. Stream re-watering • Upon project completing, slowly re-water the construction site to prevent loss of surface water downstream as the construction site streambed absorbs water and to prevent a sudden release of suspended sediment.	Reduces potential mortality	Impacts to Individuals	Miles of Heavy Mechanical Stream Restoration
AQ025	Avoid water withdrawals from streams bearing aquatic species whenever possible. Water drafting must take no more than 10% of the stream flow and must not dewater the channel to the point of isolating species. Pump intakes shall have fish screens of 3/32 inch mesh or less and will have an intake flow of less than 1 foot/second to prevent entraining fish. Biologists must be consulted in all situations when pumping water from streams or other natural waterbodies.	Reduces potential mortality	Impacts to Individuals	Miles of Heavy Mechanical Stream Restoration

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
AQ026	Avoiding discharging water from one source into a different body of water, such as dumping unused water from a water tender in or near a water body other than the water body from which it was acquired.	Reduces potential introduction or spread of exotic and aquatic invasive species	Pollutants/ Exotic & Invasive species	All Measures
AQ031	Imported gravel for use in or around aquatic systems must be free of invasive species, non-native seeds, and aquatic diseases. If necessary, wash gravel prior to placement and allow it to completely dry for a minimum of 2 days to prevent spread of chytrid fungus. More time for drying may be needed depending on the amount of gravel.	Reduces potential introduction or spread of exotic and aquatic invasive species	Pollutants/ Exotic & Invasive species	Miles of Heavy Mechanical Stream Restoration, Miles of ML-1 Roads
AQ032	Off and Side Channel Stream Habitat Restoration: When a proposed side channel will contain >20% of the bankfull flow, the Action Agencies will ensure that the action is reviewed by the Forest or Regional Fisheries Biologist and the Forest or Regional Engineer. Data requirements and analysis for off- and side-channel habitat restoration include evidence of historical channel location, such as land use surveys, historical photographs, topographic maps, remote sensing information, or personal observation. Allowable excavation – Off- and side channel improvements can include minor excavation (<10% of volume) of naturally accumulated sediment within historic channels. There is no limit as to the amount of excavation of anthropogenic fill within historic side channels as long as such channels can be clearly identified through field or aerial photographs. Excavation depth will not exceed the maximum thalweg depth in the main channel. Excavated material removed from off- or side-channels shall be hauled to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity.	Reduces potential changes in peak flows	Riparian Condition	Miles of Heavy Mechanical Stream Restoration
AQ033	Ensure that an experienced engineer, fisheries biologist, wildlife biologist, hydrologist and geomorphologist are involved in the design of all aquatic restoration projects. The experience should be commensurate with technical requirements of a project and needs to involve all.	Reduces potential changes in peak flows and reduces loss of aquatic habitat	Riparian Condition Aquatic habitat	Miles of Heavy Mechanical Stream Restoration

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
AQ034	Replant each area requiring revegetation prior to or at the beginning of the first growing season following instream or riparian restoration activities. Achieve reestablishment of vegetation in disturbed areas to at least 70% of pre-project levels within three years. Barriers will be installed as necessary to prevent access to revegetated sites by ungulates or unauthorized persons.	Reduces potential erosion, sedimentation, bank instability and loss of streamside vegetation	Riparian Condition	Miles of Heavy Mechanical Stream Restoration
AQ035	During all implementation, maintain shade, bank stability, and large woody material recruitment potential.	Reduce potential loss of streamside vegetation, LWD recruitment, and increased stream temperatures	Riparian Condition	All Measures
AQ036	Inspect daily for fluid leaks before leaving the vehicle staging area for operation.	Reduces potential contamination of water bodies	Pollutants/ Exotic & Invasive species	All Measures
AQ037	For stream restoration, live conifers and other trees can be felled or pulled/pushed over for in-channel large wood placement in streams or floodplains only when conifers and trees are fully stocked. Tree felling shall not create excessive stream bank erosion or increase the likelihood of channel avulsion during high flows.	Reduce potential loss of streamside vegetation, LWD recruitment, and increased stream temperatures	Riparian Condition	Miles of Heavy Stream Restoration
AQ038	Within the primary shade zone retain 100% of the over-story canopy closure, unless other exceptions listed below are met. Source trees being extracted (either by tipping and/or felling) for stream restoration will not be cut from within the primary shade zone. Hill Slope — Primary Shade Zone Width (slope distance) <30% — 50 ft. 30-60% — 55 ft. >60% — 60 ft. The distances listed above to be less (but not less than 25 ft.) if any of the following conditions apply: • The trees are located on a south facing slope and therefore do not provide stream shade; • An appropriate level of analysis is completed and documents, such as shade modeling with LiDAR, using site-specific characteristics to determine the primary shade tree width; and/or • Field monitoring or measurements are completed to determine the width where Optimum Angular Canopy Density (65% or greater) is achieved. • If trees are being felled for safety reasons they can be felled towards the stream.	Reduce potential loss of streamside vegetation, LWD recruitment, and increased stream temperatures	Riparian Condition	Acres of Mechanical thinning, Miles of Heavy Stream Restoration

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
FE003	As burn plans and burn units are developed, ensure consideration is given to the spatial and temporal effects of broadcast burning in the upper levels of a watershed.	Reduces potential erosion, sedimentation, bank instability and loss of streamside vegetation, and changes in peak flows	Riparian Condition	Acres of Prescribed Burning
FE006	Burning within narrow-headed garter snake occupied habitat or proposed critical habitat will not occur during the hibernation period (December - February) when garter snakes are more likely to be hibernating in wood piles, debris jams, etc., unless cleared by the district biologist.	Reduces potential mortality	Impacts to Individuals	Acres of Prescribed Burning
FE007	Ignitions will not occur within any AMZ, unless approved by a watershed specialist and/or a biologist.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Prescribed Burning
FE008	Firelines would be used to facilitate prescribed fire operations as needed to balance fire management and other resource protection objectives: (1) Firelines may consist of natural barriers, roads and trails, or may be constructed, if necessary, in coordination with other resource specialists. (See SW015) (2) Fireline width would be determined as adjacent fuels and expected fire behavior dictate, assuming compliance with the requirements of cultural, wildlife, and other resource areas. (3) Constructed firelines would be rehabilitated when they are no longer needed, using methods appropriate to the site.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Prescribed Burning
FE009	Burning within narrow-headed garter snake occupied habitat or proposed critical habitat will not occur during the hibernation period (December - February) when garter snakes are more likely to be hibernating in wood piles, debris jams, etc., unless cleared by the district biologist.	Reduces potential mortality	Impacts to Individuals	Acres of Prescribed Burning
FE013	Mechanical treatments following broadcast burns would occur after surface vegetation has recovered sufficiently to minimize soil disturbance from the mechanical treatments. Prescribed fire treatments following mechanical treatments would occur after there has been adequate surface vegetation recovery that fuel loads are sufficient to meet the objectives of a prescribed burn.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Mechanical thinning and Prescribed Burning

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
RM004	Rest or deferment of a pasture by livestock may occur after the completion of ground disturbing activities, such as burning and mechanical thinning. Range management personnel will evaluate conditions to determine when adjustment to livestock management, such as rest of deferment of a pasture is needed. Several factors may be used to assist in these determinations, such as plant recovery, plant vigor, and size of the disturbed area in relation to the pasture size. Plants that are well rooted, have multiple leaves or branches, and/or are producing seed head or flowers provide evidence of plant recovery, vigor, and reproductive ability.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Mechanical thinning and Prescribed Burning
SI001	Non-commercial tree thinning is allowed only as required to adjust fuel loads to implement a low- to moderate-severity burn to promote growth of deciduous trees and shrubs, such as aspen, cottonwood, willow, other deciduous species, and associated meadows.	Reduces potential loss of streamside vegetation, LWD, and increased stream temperature	Riparian Condition	Acres of Mechanical thinning and Prescribed Burning
SI003	All snags will be maintained within the AMZ unless deemed a hazard tree.	Reduces potential loss of LW	Riparian Condition	Acres of Mechanical thinning and Prescribed Burning
SI008	Source trees for placement in streams should come from but are not limited to: over or fully stocked upland and riparian stands, hazard trees, trees that have fallen naturally and are still suitable, trees generated from administrative sites (maintenance, expansion, or new construction), and hardwood restoration.	Reduces potential loss of streamside vegetation and increased stream temperature	Riparian Condition	Acres of Mechanical thinning and Miles of Heavy Stream Restoration
SI012	Trees may be stock piled for future instream restoration projects.	Reduces potential erosion, sedimentation, and loss of streamside vegetation, and increased stream temperature	Riparian Condition	Acres of Mechanical thinning and Miles of Heavy Stream Restoration
SI023	Tree and shrub species, willow cuttings, as well as sedge and rush mats to be used as transplant material shall come from outside the bankfull width, typically in terraces (abandoned floodplains), or where such plants are abundant.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Miles of General and Heavy Mechanical Stream Restoration

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW001	All stream channels will be protected with Aquatic Management Zones (AMZs), measured as the slope distance from the edge of each side the stream. Where AMZ widths are not customized to site conditions and don't occur in Narrow-headed or Northern Mexican Garter Snake proposed critical habitat (see AQ021), the default minimum width for ground-based mechanical and prescribed burning treatments for perennial, intermittent, and ephemeral streams are 150, 75, and 50 feet, respectively. Lakes and reservoirs should follow the same default AMZ widths (150 feet) as those for perennial waters.	Reduces potential erosion and sedimentation	Riparian Condition	All Measures
SW002	AMZs can be customized by an ID team of qualified specialists prior to project implementation based on desired conditions along the stream reach and the nature of resource values at risk (such as the presence of aquatic ESA species or its potential introduction), special concerns for water quality degradation, erosion hazard, existing vegetative ground cover conditions, stream bank and riparian conditions, natural geologic features, and flow regime. The IDT will determine appropriate AMZ widths and treatment limitations within these zones. These changes should be reflected in the plan-in-hand documents and included in the task order or contract maps.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Impacts to Individuals Riparian Condition	All Measures
SW004	Accepted activities within AMZs include mechanical and conventional tree felling, yarding, skidding, backing fire. Landings, decking areas, machine or hand piles, and skidding across streams or wetlands are to occur outside of AMZs unless otherwise specified. Skidding across ephemeral or intermittent streams may occur at designated crossing under no-flow conditions.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes in peak flows	Riparian Condition	Acres of Mechanical Thinning
SW005	If completing mechanical vegetation treatments within an AMZ, the preferred method of using feller-buncher or grapple skidder equipment is to approach the material to be extracted on the contour as much as possible to the stream, then back equipment out. Turning machines and skidding within AMZs should be minimized to the greatest extent possible.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Mechanical Thinning, Miles of Heavy Mechanical Stream Restoration
SW006	Landings, log decks, and piles (burn, slash, or biomass) should be placed in upland locations and will not be allowed in areas such as: meadows, riparian areas, springs, seeps, AMZs, stream channels, or at the heads of stream channels. Landings, log decks and burn piles will be located outside at least 100 feet from these features, far enough away that direct (unfiltered) entry of sediment, bark, ash and burning products will not enter. The authorized FS officer AND a watershed specialist may authorize landings in these areas if absolutely required.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Mechanical Thinning

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW007	Mechanical vegetation treatments within AMZs will minimize the amount of thinning debris deposited in stream channels and remove excess debris by hand or end-lining with one end suspension except where coarse woody debris is needed for stream health as identified by fisheries or watershed specialists. Remove thinning debris less than six inches in diameter and less than six feet long and place it above the ordinary high water mark.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Mechanical Thinning, Miles of Heavy Mechanical Stream Restoration
SW008	Mechanical vegetation treatments within AMZs will fell trees outside the stream channel unless otherwise specified as a stream treatment.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Mechanical Thinning
SW009	If completing mechanical vegetation treatments within an AMZ, do not cut trees where the root system is important in maintaining channel morphology.	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Mechanical Thinning
SW010	New temporary road construction is not allowed in AMZs.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Qualitative Temporary Roads
SW011	Establish staging areas 150 feet outside of AMZs or from natural water bodies and wetlands for storage of vehicles, equipment and fuels, and fueling/servicing areas to minimize erosion into or contamination of streams, wetlands, and floodplains.	Reduces potential introduction of contaminants of aquatic habitats	Pollutants/ Exotic & Invasive species	All Measures
SW012	Site-specific criteria whereby either fire is allowed to burn in AMZs or is actively ignited will be solely driven by the need to maintain or improve riparian and stream habitat. A site-specific evaluation will be conducted by a specialist as a part of the burn plan for each unit where fire is proposed.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Prescribed Burning
SW013	Fire control lines shall only be constructed within AMZs if mutually agreed upon by the authorized FS officer, fuels specialist, watershed specialist, and biologist. Only the following are allowed in AMZs: Raking, brushing (less than 3 feet wide), leaf-blower, or other techniques that do not disturb soils or cause erosion.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition	Acres of Prescribed Burning
SW014	The following direction should be incorporated in developing the burn plan: High soil burn severity should not occur on greater than 5 percent areal extent of the uplands or an AMZ in each burn unit. High severity should be patchy rather than concentrated. No more than 5 percent mortality is allowed in the mature forest canopy along a streamside in each burn unit, with this mortality occurring as discontinuous patches. Variance in these parameters would need to be approved by appropriate specialist(s).	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Prescribed Burning

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW016	Do not apply surface fertilizer within an AMZ.	Reduces potential introduction of contaminants of aquatic habitats	Pollutants/ Exotic & Invasive species	All Measures
SW017	Domestic livestock grazing within an AMZ affected by prescribed fire will be deferred until ground cover is adequately re-established.	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Prescribed Burning
SW018	During project implementation use existing system travel courses and stream crossings whenever possible, unless new construction would result in less resource disturbance. Minimize the number of temporary access roads and travel paths to lessen soil disturbance, compaction, and impacts to vegetation. Temporary roads will not be built on slopes where grade, soil, or other features suggest a likelihood of excessive erosion or failure. Temporary roads areas will be restored to natural, preconstruction conditions as much as possible.	Reduces potential erosion, sedimentation, and loss of streamside vegetation	Riparian Condition Habitat Connectivity Impacts to Individuals	All Measures
SW020	Spill prevention, containment, and counter measure plans are required if the fuel exceeds 660 gallons in a single container or if the total fuel storage at a site exceeds 1,360 gallons.	Reduces potential introduction of contaminants of aquatic habitats	Pollutants/ Exotic & Invasive species	All Measures
SW021	Any leaks originating from contractor equipment shall be repaired or the equipment replaced in a timely manner.	Reduces potential introduction of contaminants of aquatic habitats	Pollutants/ Exotic & Invasive species	All Measures
SW022	During servicing and refueling of equipment, pollutants shall not be allowed to enter any waterway, riparian area or stream course. Construct berms where necessary to contain potential spills. An authorized FS Official shall also be aware of actions to be taken in case of a hazardous substance spill.	Reduces potential introduction of contaminants of aquatic habitats	Pollutants/ Exotic & Invasive species	All Measures
SW023	Equipment operators shall maximize that recovery and proper disposal of all fuels, fluids, lubricants, empty containers, and replacement parts.	Reduces potential introduction of contaminants of aquatic habitats	Pollutants/ Exotic & Invasive species	All Measures
SW026	Heavy equipment, vehicle operation, road construction, staging areas, stockpile areas, piling of slash, fence construction, fire lines, and other operational activities shall not be allowed in springs, seeps, or any other Groundwater-dependent Ecosystem (GDE), unless it is for the benefit or protection of the GDE or development of the springs.	Reduces potential introduction of contaminants of aquatic habitats	Pollutants/ Exotic & Invasive species	All Measures
SW027	At spring development restoration sites, place watering troughs far enough from a steam or surround with a protective surface to prevent sediment delivery to the stream. Avoid steep slopes and areas where compaction or damage could occur to sensitive soils, slopes or vegetation due to congregating livestock or wildlife.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW028	At spring restoration sites, ensure that each livestock or wildlife water development has a float valve or similar device, a return flow system, a fenced overflow area, or similar means to minimize water withdrawal and potential runoff and erosion.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	
SW032	Formerly used skid trails should be utilized where properly located. The designation of new skid trails should be oriented to the contour of the slope as much as operationally feasible. Skid trail design should minimize concentrated runoff and sediment delivery by avoiding long, straight skid trails and providing breaks in grade.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW033	Closed skid trails and roads must have adequate runoff and erosion control features. Slash is the preferred method for diverting water if of sufficient quantity and size is available to maintain complete contact with the ground. Otherwise construct water bars and lead out ditches. Waterbars should not be more than 2 feet deep and need at least a 10-foot lead-out. Waterbars are only to be implemented with equipment with an articulating blade (no skidders), or by hand to remove berms, seeded, mulched, and cross-ripped. Waterbar spacing should be approximately 130 feet for slopes 0-5%, and 100 feet for slopes 6-10%. All berms and depressions (i.e., ruts) created along the skid trail or road will be filled in to restore the natural grade of the slope as much as possible.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW034	Erosion control structures and measures must be in place prior to the first erosive event. Contracts and agreements should outline the timing and application of erosion control methods to minimize soil loss and sedimentation of stream courses.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	All Measures
SW041	Skid trail stream crossings will not be allowed unless pre-approved by the authorized FS officer AND a watershed specialist for perennial and intermittent streams. Ephemeral streams crossings will be authorized by the FS officer. Crossings will be at right angles to channel and drainage banks. The number of designated crossings should be minimized.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW043	Culverts, temporary bridges, low-water crossings, or log-fords will be required on all temporary roads and skid crossings on all streams that will have flowing water during the life of the temporary crossing. Temporary road and skid trail crossings will be removed when no longer needed. Any fill material will be removed and the channel and stream banks restored to a pre-project condition.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Qualitative Temporary Roads

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW0044	During thinning, operators shall avoid excavating skid trails whenever practical.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW045	During thinning, operators shall locate skid trails where the need for sidecasting is minimized	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW046	During thinning, avoid adverse skidding to the greatest extent possible unless specialized equipment capable of adverse skidding without creating adverse soil impacts is utilized	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW047	Slash should be distributed throughout skid trails, forwarder trails and cable corridors wherever mineral soils are exposed.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW048	Operators shall limit cable thinning to uphill yarding whenever practical. When downhill cable yarding is necessary, operators shall layout the cutting system in a manner which minimizes soil displacement.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW049	Operators shall minimize the yarding of logs across streams or wetlands	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW050	Cable yarding across ephemeral streams shall be performed in ways that minimize soil and bank disturbances.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW051	Operators shall minimize the numbers and widths of yarding corridors.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW052	Where it is necessary to yard across intermittent or perennial streams or wetlands, it shall be done by swinging the yarded material free of the ground to the greatest extent practicable (i.e., full suspension)	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW053	During cable thinning, operators shall install effective cross ditches that drain onto undisturbed forest floor on all skid trails and cable corridors located on steep or erosion-prone slopes.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW054	Location of new skid trails and overall skid trail placement should be designed to minimize the overall disturbance footprint across the treatment unit while still meeting the objectives of the stand treatment.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW056	Sizing, spacing, and placement of landings should be designed to minimize the overall ground disturbance footprint across the treatment unit while still meeting the objectives of the stand treatment.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW057	Heavy ground disturbance activity areas (landings, major skid trails, unsurfaced haul roads, etc.) and excessive ground disturbance in any location (i.e., exceeding the rutting guidelines) should aim to not exceed 15 percent - areal extent of a treatment unit within a timber sale area.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW058	Skid trails, landings, and temporary roads are to be closed post-treatment and landings are to be scarified and seeded with a certified weed-free mix of primarily native, perennial grasses. The Coconino NF does not require scarification unless compaction is present.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW060	When thinning trees, no skidding is allowed across wetlands or springs and their outflows.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning
SW063	Wet Meadows, springs, seeps or other wet features where mechanized equipment is to be excluded will be designated as “protected areas” be clearly labeled on task order or contract maps and marked on the ground. Any features discovered during the layout phase of a project will also be included on task order or contract maps and boundaries shall be delineated on the ground during layout.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning. Miles of Heavy Mechanical Stream Restoration
SW064	Only hand-felling methods will be permitted when removing trees from designated protected areas and other sensitive areas such wet meadows, or around springs, seeps, and other wet features unless approved by a watershed specialist or a biologist. The use of end-lining for removal of encroachment trees in these areas will be determined on a case-by-case basis by the authorized FS officer AND a watershed specialist.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning. Miles of Heavy Mechanical Stream Restoration

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW066	Mechanized equipment usage for thinning timber or biomass will be restricted to slope gradients of 25 percent or less on fragile or sensitive soil types (e.g., cinder cones).	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning. Miles of Heavy Mechanical Stream Restoration
SW067	Whether identified pre-implementation and on a task order/contract area map OR during the implementation phase, locations above 25 percent slope gradient on sensitive soil types will include a "protected area" designation that is clearly marked to exclude the use of mechanized thinning equipment. Hand-felling methods only will be permitted in these locations.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning. Miles of Heavy Mechanical Stream Restoration
SW068	Use of specialized thinning equipment may allow operations on steeper slopes. Viability and authorization of specialized equipment use above these slope gradients will be determined during the layout phase of a sale by the pre-sale forester AND a watershed specialist. This equipment must be specified in the contract.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Mechanical Thinning. Miles of Heavy Mechanical Stream Restoration
SW069	All ground disturbing activities using heavy equipment must be done under conditions which maintain soil condition (i.e. avoiding excess rutting, compaction, and displacement).	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Mechanical Thinning, Miles of Heavy Mechanical Stream Restoration
SW070	Skid Trails: Allow up 6 inches of rutting over no more than 15 percent areal extent along a skid trail (two or more drags being considered a skid trail). Depth of rut is a measurement from the bottom to the top of a berm. Slope gradients of 20 percent or more will be considered on a case-by-case basis.	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Mechanical Thinning
SW071	At landings and within 75 feet of landings, rutting depths greater than 10 inches will not be allowed. Equipment shall not be turned on roads. Landings on slopes will be minimized to the greatest extent practicable and soil and watershed mitigation measures will be applied on a case by case basis to ensure that unacceptable soil loss does not occur.	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Mechanical Thinning
SW072	Rutting will not exceed 8 inches depth for more than 75 linear feet or 10% of road length, whichever is shorter. Rutting in excess of 3 inches depth will not be permitted on surfaced collector or arterial roads. If unsurfaced, guideline will be the same as for terminal and service roads.	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Mechanical Thinning

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW074	No fire control lines should be constructed using mechanized equipment on slopes greater than 40 percent or greater than 25 percent on identified fragile or sensitive soil types.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Prescribed Burning
SW075	If fire control lines are constructed, rehabilitate lines after use by either rolling berm back over the entire fire line, spreading slash across the fire line, or water barring the fire line. If water barring only, vary spacing dependent on slope and disguise the first 400 feet of line to discourage use as a trail.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Acres of Prescribed Burning
SW077	High soil burn severity fire should occur on no more than 5 percent of the entire treatment area for all prescribed fire in the project area.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Prescribed Burning
SW078	Burn plans will be designed to minimize fire intensity in riparian areas that have a PFC rating of Nonfunctional or Functional-at-Risk with a downward trend.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Prescribed Burning
SW079	Avoid treatment intensities (mechanical thinning and prescribed burning) which may cumulatively produce undesirable effects in subwatersheds. A watershed specialist will evaluate the potential for adverse cumulative subwatershed effects prior to implementation. Methodologies may include but are not limited to an Equivalent Disturbed Area analysis or watershed modeling software. If it is determined that potential cumulative effects may be adverse to watershed function and condition, treatments can be spread out spatially and/or temporally.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical thinning and Prescribed Burning
SW080	If a watershed analysis is not completed, the default limit of areal extent of mechanical vegetative treatments which may occur in a subwatershed (HUC12) is 25% in a given year and 40% over 5 years of that subwatershed. For prescribed burning the percentages of subwatershed treated can be doubled over the same time periods.	Reduces potential erosion, sedimentation, loss of streamside vegetation, and changes to peak flows	Riparian Condition	Acres of Mechanical thinning and Prescribed Burning
SW081	When restoring floodplains, mimic to the extent possible, the elevation, width, gradient, length, and roughness that would occur naturally for that stream reach and associated valley type.	Reduces potential changes to peak flows	Riparian Condition	Miles of Heavy Mechanical Stream Restoration

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW082	Without changing the location of the bank toe, restore damaged streambanks to a natural slope and profile suitable for establishment of riparian vegetation. This may include sloping of unconsolidated bank material to a stable angle of repose or the use of benches in consolidated, cohesive soils.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Miles of Heavy Mechanical Stream Restoration
SW083	Road erosion control, such as lead-out ditches or water bars, shall be constructed to hydrologically disconnect road surface runoff from stream channels.	Reduces potential sedimentation and changes to peak flows	Riparian Condition	Miles of ML-1 Roads, Qualitative Temporary Roads
SW086	Relocated trails or roads will be constructed in a manner that does not hydrologically connect them to stream courses to the extent practical. Relocated roads and trails will have sufficient drainage features to maintain the integrity of the traveled way. New cross drains shall discharge to stable areas where the outflow will quickly infiltrate the soil and not develop a channel to a stream.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Qualitative Relocation of Roads/Trails
SW087	Site rehabilitation on riparian sites for stream channel and road reconstruction projects where ground disturbance occurs: seed at 5 pounds per acre or other appropriate rate with certified weed-free native seed mix to rehabilitate the site and minimize effects of noxious weeds.	Reduces potential erosion, sedimentation, and loss of streamside cover	Riparian Condition	Miles of Heavy Mechanical Stream Restoration, Miles ML-1 Roads, Qualitative Road and Trail Decommission -ing and Relocation
SW088	**Site rehabilitation on disturbed sites and stream channel shaping on previously decommissioned roads**: Site rehabilitation consists of several revegetation methods, such as, but not limited to: (1) Storing sod removed from the initial ground disturbance and replace the sod from the top of the bank on the disturbed site; (2) Use appropriate mix of species that will achieve vegetation establishment and erosion control objectives at the site. (3) Protect site with slash spread across the disturbed area to create microclimates and protect from grazing ungulates. Slash placement should be limited to the upper two-thirds of the bank to limit transport downstream of woody material;(4) Consider the use of mycorrhizal inoculum on severely disturbed sites where no topsoil is left; and (5) install erosion mat.(6) Protect site with herptile-friendly barriers until the site has reestablished. Temporary erosion control should be installed before land or channel disturbing activities commence and will be inspected for adequacy/effectiveness at sufficient intervals to minimize adverse effects to soils or surface water quality.	Reduces potential erosion, sedimentation, and changes to peak flows	Riparian Condition	Qualitative Relocation of Roads/Trails

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW093	For road, trail, aquatic, and watershed treatments: dispose of slide and waste material in stable sites out of the flood-prone area. Use native materials to restore natural or near-natural contours.	Reduces potential erosion and sedimentation	Riparian Condition	Miles of Heavy Mechanical Stream Restoration, Miles ML-1 Roads, Qualitative Road and Trail Decommission-ing and Relocation
SW096	Minimize clearing and grubbing activities when preparing staging, project, and or stockpile areas. Any large wood, topsoil, and native channel material displaced by construction will be stockpiled for use during restoration. Materials used for implementation of aquatic and watershed restoration categories (e.g., large wood, boulders, fencing material) should be staged out of the 100-year floodplain.	Reduces potential mortality and sedimentation	Impacts to Individuals Riparian Condition	Heavy Mechanical Stream Restoration
SW097	Minimize time in which heavy equipment is in stream channels, riparian areas, and wetlands. Complete earthwork as quickly as possible and prior monsoon season. During excavation, stockpile native streambed materials above the bankfull elevation, where it cannot reenter the stream, for later use.	Reduces potential mortality and sedimentation	Impacts to Individuals Riparian Condition	Heavy Mechanical Stream Restoration
SW099	Streambank vegetation will be protected except where its disturbance or removal is absolutely necessary for completion of the work.	Reduces potential sedimentation and loss of streamside vegetation	Riparian Condition	Heavy Mechanical Stream Restoration
SW100/ TR012	Do not borrow road fill or embankment materials from the stream channel or meadow surface on road maintenance or stream crossing projects. Compact (compress) the fill dirt.	Reduces potential sedimentation	Riparian Condition	Miles of ML-1 Roads, Qualitative Temporary Roads
SW103	Soil and vegetation disturbance would be avoided to the extent practicable. Clear only the area needed for expansion of the pit.	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Rock Pits
SW105	Erosion control work would be kept current immediately preceding expected seasonal periods of precipitation or runoff.	Reduces potential erosion and sedimentation	Riparian Condition	All Measures
SW108	Mine pit areas would be designed to be internally draining during mining activity.	Reduces potential pollutants and sedimentation	Riparian Condition Exotic & Invasive species, Riparian Condition	Acres of Rock Pits

ID #	Design Feature	Relationship reduced or eliminated	Resource Indicator	Measure
SW110	Stockpiled material should be placed and shaped to prevent water from ponding and to direct water to a drainage system.	Reduces potential sedimentation	Riparian Condition	Acres of Rock Pits
SW111	Keep sediment on-site using settling ponds, check dams, or sediment barriers; and monitor and inspect the site frequently and correct problems promptly. Ponds should be cleaned out before they are more than 1/3 full of sediment.	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Rock Pits
SW112	Removal of pit material will not involve disturbance of riparian areas or alteration of streambeds and/or floodplain.	Reduces potential erosion, sedimentation and loss of streamside vegetation	Riparian Condition	Acres of Rock Pits
TR001	Avoid locating temporary roads on soils with severe erosion hazard.	Reduces potential erosion and sedimentation	Riparian Condition	Qualitative Temporary Roads
TR002	On areas to be prescribed burned, if decommissioned roads are used as fire lines, return decommissioned roads to their pre-burn condition. Rehabilitation of the surface should refer to the soil and water BMPs for rehabilitation of fire lines and disturbed areas.	Reduces potential erosion and sedimentation	Riparian Condition	Acres of Prescribed Burning
TR003	Where temporary road construction is unavoidable, provide soil protection through implementation of any of the following methods to control sediment and protect water quality. Methods may include, but are not limited to: wattling, hydro-mulching, straw or wood-shred mulching, spread slash, erosion mats, terraces, blankets, mats, silt fences, riprapping, tackifiers, soil seals, seeding and side drains, and appropriately spaced water bars or water spreading drainage features.	Reduces potential sedimentation	Riparian Condition	Qualitative Temporary Roads
TR011	Roads causing damage to hydrological resources, cultural resources or threatened endangered, and sensitive species habitat are a priority for decommissioning.	Reduces potential erosion, sedimentation, and loss of riparian vegetation	Riparian Condition Impacts to Individuals Habitat Connectivity	Qualitative Road and Trail Decommission-ing
TR013	Where feasible, relocate roads out of drainage bottoms to an upland location. If this is not feasible, rock armor outfall of drainage features as an energy dissipater.	Reduces potential sedimentation	Riparian Condition	Qualitative Road Relocation
TR014	Avoid road rehabilitation and maintenance during periods of sustained or heavy rainfall.	Reduces potential sedimentation	Riparian Condition	Miles of ML-1 Roads

Environmental Consequences

Alternative 1 – No Action

There would be no direct effects on resource indicators for aquatic species and habitats as a result of the no action alternative, however there would be indirect effects by not moving these resources towards desired conditions. Existing conditions for watersheds would remained degraded and associated loss of habitat would continue which could potentially lead to reductions in populations over time.

Under the No Action Alternative, current conditions within subwatersheds could potentially degrade over time. Overstocked and dense stands within the project area would not be treated, leaving a less healthy, less vigorous, and under productive forest. Encroachment of conifers into riparian areas and wetlands would continue which could decrease shrub and herbaceous ground cover as well as soil hydrologic function (Brown 2018). Decreased ground cover and soil function can lead to increased overland flow, erosion, and sedimentation reducing riparian condition and aquatic habitats. Therefore, there is a potential loss of water available for stream flow during dry summer months due to unusually high amounts of water that are lost to overland flow and/or evapotranspiration due to high canopy densities. If current conditions degrade in reference to uplands, then associated riparian condition and aquatic habitat could also degrade, not meeting the need of protection and improvement of aquatic and riparian dependent species habitat. Furthermore, by perpetuating unusually high stand densities the probability for catastrophic fire increases. Uncharacteristic wildfire has the potential to greatly reduce riparian condition and aquatic resources by leaving no shade adjacent to streams (increased stream temperatures), denuding subwatersheds of vegetation thereby leaving exposed soils (increased sediment in streams) and resulting in ash flows.

This alternative would result in no additional acres of ground disturbance or associated actions to riparian condition, habitat connectivity, aquatic habitat, individuals, or increase pollutants/introduced species. Sediment delivery to riparian areas, streams and wetlands would continue at current rates or gradually increase from poor upland conditions. Peak flows may also continue to be altered by reduced soil moisture storage and infiltration capacity producing high peak flows of short duration during high intensity summer precipitation events. Such peak flows can overwhelm riparian areas and streams altering associated riparian and aquatic habitat.

Under the no action alternative, roads would not be decommissioned and the drainage network of a streams remains unnaturally higher. Roads can directly affect the channel morphology of streams by accelerating erosions and sediment delivery and by increasing the magnitude of peak flow. Indirectly, if current conditions degrade then habitat for aquatic species will also degrade. The more roads and stream crossings there are, the higher the probability of sediment delivery to streams, negatively affecting the hydrologic function. In addition, roads affect the hydrograph and drainage density, increasing peak flows and decreasing low flows. This alternative does not meet the need for improvement of aquatic habitat.

The level of risk associated with riparian and watershed conditions as well as species and habitats would be higher with this alternative since the amount and intensity of aquatic restoration would be much less. Furthermore, federally listed native fish would also be at a higher risk of extirpation under current conditions (climate change, low viability, degraded baseline conditions) as it is assumed that minimal aquatic restoration would occur via other projects with the No Action Alternative.

Since no treatments of any kind would be implemented, there would be no direct effects to aquatic resource indicators except for existing Forest Service Roads at road/stream crossings. (Table 33). However, the potential for substantial indirect effects would exist through failure to reduce current fuel

loading conditions that could result in uncharacteristic stand replacing wildfire. This could result in the reduction of riparian condition through loss of canopy cover and structure, increased sedimentation and ash, increased peak flows, and reduction or loss of large wood recruitment. These potential changes in riparian conditions would also result in decreases in food resources, habitat quality, and quantity. Uncharacteristic wildfire in within riparian areas and streams could harm or reduce species populations either directly or indirectly through alteration of habitat.

Under this alternative, conditions in existing or potential habitat that provide for aquatic species would remain in their current condition, notwithstanding natural processes. No restoration of streams, floodplains, wetlands, or riparian areas would occur. Conifer encroachment would continue into wet and dry montane meadows. Riparian vegetation would reflect conditions that are suited towards a dryer climate such as grasses. Grass species have less root mass than riparian species and therefore do not have the ability to stabilize the incised streambanks. Current riparian and watershed conditions of Functioning at Risk or Impaired would continue to limit the quality of aquatic habitat and therefore species occupancy. Consequently, Alternative 1 would not be beneficial for riparian condition, aquatic habitat quality or quantity.

Table 33. Resource indicators and measures for Alternative 1 by species.

Species	Mechanical Thinning Acres	Prescribed Burning Acres	Miles of Open Forest Service Roads	IWPS Acres	Rock Pit Acres	General /Heavy Mechanical Stream Restoration Miles
Gila trout	0	0	0	0	0	0/0
Gila chub	0	0	0	0	0	0/0
Gila topminnow	0	0	0	0	0	0/0
Little Colorado spinedace	0	0	0	0	0	0/0
Little Colorado spinedace CH	0	0	0	0	0	0/0
Loach minnow	0	0	0	0	0	0/0
Razorback sucker	0	0	0	0	0	0/0
Spikedace	0	0	0	0	0	0/0
Narrow-headed gartersnake & CH	0	0	0	0	0	0/0
Northern Mexican gartersnake & CH	0	0	0	0	0	0/0
Desert Sucker	0	0	0	0	0	0/0
Sonoran Sucker	0	0	0	0	0	0/0
LC sucker	0	0	0	0	0	0/0
Headwater chub	0	0	0	0	0	0/0
Roundtail chub	0	0	0	0	0	0/0

Alternative 2 – Modified Proposed Action

Direct and Indirect Effects - Alternative 2

Mechanical Vegetation Treatments

For Alternative 2, acres of mechanical vegetation treatments has the potential for negative short and mid-term impacts to riparian condition and individuals. Direct negative short term impacts would result if these activities occur in a species habitat from actions such as yarding, skidding, or harm to gartersnakes during mechanical operations. Alternative 2 is proposing treatments within the habitats of seven fish species and both gartersnakes. Increases in acreages of treatments ranges from 203 to 3,891 acres which equates to 1% - 100% of the analysis area for direct effects for those species. Five fish species would not be directly impacted by mechanical vegetation treatments under Alternative 2. Table 34 displays this information for each species.

Table 34. Change by species in the acres of mechanical vegetation treatments for Alternative 2 as compared to Alternative1. Percentages reflect increases in acreage within direct effects analysis areas for species.

Species	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 2: Acre of Mechanical Vegetation Treatment Acres/ Percentage of Direct Effects Area
Gila trout	0	1,398/ 52%
Gila chub	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	0	203/ 1%
Little Colorado spinedace CH	0	161/
Loach minnow	0	0/ 0%
Razorback sucker	0	0/ 0%
Spikedace	0	0/ 0%
Narrow-headed gartersnake & CH	0	2,266/ 93%
Northern Mexican gartersnake & CH	0	1,249/ 100%
Desert Sucker	0	3,891/ 29%
Sonoran Sucker	0	573/ 39%
Little Colorado sucker	0	3,292/ 25%
Headwater chub	0	1,939/ 55%
Roundtail chub	0	1,581/ 26%

Mechanical vegetation treatments can negatively impact riparian condition short to mid-term when they occur within the direct effects analysis area. Direct impacts of reduced riparian vegetation cover or structure could occur by removal of trees or crushed by machinery. These are also direct impacts to gartersnake critical habitat as well as habitat for some aquatic macroinvertebrates species. Indirect impacts of increased stream temperature from loss of canopy cover could occur, but should be limited based on design features associated with providing for and protection of existing stream shade. Indirect impacts of ground disturbance and increased sediment delivery to streams is expected to occur short to mid-term until ground cover is reestablished. Stream banks can be also be damaged, which are primary constituent element for some fish, however design features for mechanical vegetation treatments

including restrictions for skid trails and yarding within riparian areas as well as protecting stream banks would minimize potential impacts.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore direct and indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. Riparian condition for the remaining species is functioning at risk, therefore direct and indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and functioning at some level.

Impacts to individuals in the form of harm or modification of behavior could also occur short to mid-term. Mechanical vegetation treatments within gartersnake habitat could result in harm of individuals as a direct effect. Indirectly, gartersnakes may avoid or move out of these areas while work is occurring causing displacement or disruption of social and feeding behavior. These indirect effects have the potential to reduce the health or reproductive capability of individuals.

Long term, mechanical vegetation treatments could have a neutral or positive effect on aquatic indicators. Riparian condition could be improved by removing encroachment and restoring streamside vegetation. Conifers can impede the growth the riparian woody and herbaceous species; therefore it is expected they would increase in cover and structure. This would provide for large woody debris over time as well as decreasing sediment delivery and peak flows. Impacts to individuals would cease once activities were completed and therefore have a neutral effect long term.

For Alternative 2, increased acres of mechanical vegetation treatments also has the potential for indirect occur short to mid-term impacts riparian condition from treatments in the upper watershed. These are indirect impacts that can occur within a species action area (i.e., project watershed area that drains into a species occupied habitat) by changes in the uplands and on tributaries and drainages. Increases in percent of action areas treated under Alternative 2 range from 54% to 94%. Table 34 displays these species habitats as compared to the existing condition (Alternative 1).

Table 35. Change by species in acres of mechanical vegetation treatments for Alternative 2 as compared to Alternative 1. Percentages reflect increases in acreage within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 2: Mechanical Vegetation Treatment Acres/ Percentage of Action Area
Gila trout	0	89,699/ 81%
Gila chub*	0	12,325/ 57%
Gila topminnow*	0	11,628/ 94%
Little Colorado spinedace	0	150,627/ 55%
Loach minnow*	0	11,628/ 94%
Razorback sucker*	0	11,628/ 94%
Spikedace*	0	11,628/ 94%
Narrow-headed gartersnake	0	65, 851/ 74%
Northern Mexican gartersnake	0	38,171/ 79%
Desert Sucker	0	207,340/ 65%
Sonoran Sucker	0	37,108/ 71%
Little Colorado sucker	0	121,732/ 54%
Headwater chub	0	117,548/ 83%

Species	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 2: Mechanical Vegetation Treatment Acres/ Percentage of Action Area
Roundtail chub	0	122,186/ 76%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Mechanical vegetation treatments in uplands can indirectly impact riparian condition short to mid-term from increased sediment delivery and peak flows via removal of vegetation and ground disturbance. Soils can be compacted and water infiltration reduced from landings and skid trails leading to increased overland flow and erosion. Yarding and skidding can redirect water onto areas more likely to erode than natural channels. In turn, increased sedimentation and peak flows can occur reducing riparian condition, aquatic habitat quality and quantity.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more would reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore likely unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently functioning at risk, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Upper Fossil Creek is functioning properly. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows.

For those species with impaired or functioning at risk riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Design features related to mechanical vegetation treatments are expected to minimize the potential effects described above. The project includes spreading treatments in time and space within a watershed as well as for skid trails, yarding, and landings are expected to reduce these impacts.

Pollutants in the form of fuels and lubricants have the potential to be introduced into aquatic systems from staging areas and equipment. Spills and leaks can introduce pollutants to soils and then to streams and riparian areas reducing riparian condition and habitat quality. Design features for storm water protections plans, staging areas, fuel storage and checking equipment for leaks minimizes the potential for introduction of pollutants.

Long term, mechanical vegetation treatments are expected to improve overall watershed condition as well as riparian condition. Moving forests towards desired conditions of more a healthy, resilient state will provide for improved watershed function over time. It will also reduce the risk of uncharacteristic wildfire which can greatly impact all resource indicators and reduce aquatic habitat quality, quantity and populations. Alternative 2 will have more long term improvements to riparian condition than Alternatives 1 and 3 due to the increased overall acreage.

Prescribed Burning

For Alternative 2, acres of prescribed burning has the potential for negative short and mid-term impacts to riparian condition and harm to individuals. Direct short term impacts would result if these activities occur within species habitat from firelines, removal or reduction of vegetation due to burning or harm to gartersnakes. Alternative 2 is proposing treatments in the habitats of seven fish species and both gartersnakes (Table 35). Increases in acreage of treatments ranges from 0 to 9,405 which equates to 0%-100% of the analysis area for direct effects for those species. Five fish species directly impacted by prescribed burning under Alternative 2.

Prescribed burning can negatively impact riparian condition short to mid-term when it occurs in the direct effects analysis area. Direct impacts of reduced riparian vegetation cover or structure and decreases in large wood recruitment could occur from burning. Decreases in willows and other shrubby species reduces hiding and thermal cover for gartersnakes. This would be a direct alteration of gartersnake critical habitat as well as potentially impacting some aquatic macroinvertebrate species. This reduction is only expected to occur until vegetation recovers. Reduction in canopy cover also reduces stream shading and can increase stream temperatures. It also reduces organic matter inputs to streams which can alter food webs and prey base for fish and gartersnakes. Indirect impacts of increased stream temperature from loss of canopy cover could also occur, but should be limited based on design features associated with limiting high burn severity (mortality) and ignitions within riparian areas.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore direct and indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. They already lack adequate streamside cover and structure, therefore those factors could be more susceptible to impacts. Riparian condition for the remaining species is functioning at risk, therefore direct and indirect effects are expected to be less as they have more cover and structure. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and functioning at some level.

Long term effects of prescribed burning are expected to be positive for riparian condition. Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future. Large woody debris recruitment and streamside cover or structure can also improve with prescribed fire. Fire plays an important role in maintaining heterogeneity in riparian and aquatic systems that has been excluded similar to surrounding uplands (Gresswell 1999); therefore, restoring the fire regime would have some benefits to riparian condition.

Impacts to individual gartersnakes in the form of mortality or modification of behavior could also occur short to mid-term. Mortality could occur during prescribed burning; however, gartersnakes are mobile and design features of no burn piles within their habitat reduces that potential. While gartersnakes are more susceptible to exposure during a prescribed fire, it is more likely that harm or displacement would occur until the burns were completed. Long term impacts to individuals would be neutral or potentially positive if habitat improved and similarly increased social or feeding behavior.

Table 36. Affected acres by species and the percent of change in the acres of prescribed burning for Alternative 2 as compared to Alternative 1. Percentages reflect changes in acreages within species direct effects analysis areas.

Species	Alternative 1: Acres of Prescribed burning	Alternative 2: Acres of Prescribed Burning/ Percent of Direct Effect Area
Gila trout	0	1,541/ 57%
Gila chub	0	0/ 0%

Species	Alternative 1: Acres of Prescribed burning	Alternative 2: Acres of Prescribed Burning/ Percent of Direct Effect Area
Gila topminnow	0	0/ 0%
Little Colorado spinedace	0	9,405/ 70%
Loach minnow	0	0/ 0%
Razorback sucker	0	0/ 0%
Spikedace	0	0/ 0%
Narrow-headed gartersnake	0	2,437/ 100%
Northern Mexican gartersnake	0	1,249/ 100%
Desert Sucker	0	4,542/ 34%
Sonoran Sucker	0	630/ 43%
Little Colorado sucker	0	6,734/ 52%
Headwater chub	0	2,090/ 60%
Roundtail chub	0	1,900/ 31%

Prescribed burning in uplands can indirectly impact riparian condition short to mid-term from increased sediment delivery and peak flows for all analyzed species. For Alternative 2, the increases in percentage of action areas treated range from 57% to 97%. Table 36 displays these species habitats as compared to the existing condition (Alternative 1). However, while the five species (denoted with an asterisk) show increases, it is important to note the overall acreage is small. This is due to less than half of their overall watershed occurring within the project. Therefore, while the percent increase is large the overall potential acres of impacts are much smaller than all other species. Overall impacts would be highest for both Gila Trout and Headwater Chub as most of their action area is encompassed and lowest for Gila Chub and the four species that occur in Fossil Creek.

Prescribed burning can indirectly impact riparian condition short to mid-term from increased sediment delivery and peak flows. Loss of ground cover from burning can increase erosion and overland flow which leads to increased sedimentation and peak flows. This could reduce riparian condition, aquatic habitat quality and quantity. However, these impacts are only expected to occur until ground cover vegetation recovers and has the ability to dissipate flows and trap sediment. Design features for extent of high burn severity as well as spatial and temporal spacing of activities within a watershed are expected to minimize potential impacts.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more could potentially reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently functioning at risk, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Fossil Creek is functioning properly. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows. Overall acres of treatment for Gila chub, loach minnow, spikedace, razorback sucker, and Gila topminnow are less than half of the watersheds in which they occur further reducing potential indirect effects. Additionally, prescribed burning would only occur in the upper watershed within the project area.

For those species with impaired or functioning at risk riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Potential reductions in fish prey base could also indirectly impact gartersnakes. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Long term effects of prescribed burning in the upper watersheds are expected to be positive for riparian condition. Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future that can impact entire watersheds and have long lasting negative impacts on riparian condition, aquatic habitat quality and quantity, as well as populations of species.

Table 37. Change by species in the acres of prescribed burning for Alternative 2 as compared to Alternative 1. Percentages reflect changes in acreages within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Acres of Prescribed burning	Alternative 2: Acres of Prescribed Burning/ Percentage of Action Area
Gila trout	0	97,258/ 88%
Gila chub*	0	12,328/ 57%
Gila topminnow*	0	11,990/ 97%
Little Colorado spinedace	0	172,583/ 63%
Loach minnow*	0	11,990/ 97%
Razorback sucker*	0	11,990/ 97%
Spikedace*	0	11,990/ 97%
Narrow-headed gartersnake	0	73,184/ 82%
Northern Mexican gartersnake	0	41,628/ 86%
Desert Sucker	0	230,200/ 73%
Sonoran Sucker	0	41,398/ 79%
Little Colorado sucker	0	141,334/ 63%
Headwater chub	0	127,710/ 90%
Roundtail chub	0	135,344/ 84%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Temporary Roads

Temporary roads can cause negative impacts to riparian condition, habitat connectivity, as well as potentially introduce pollutants and or invasive species. Under Alternative 2, up to 330 miles of temporary roads could be utilized to facilitate mechanical vegetation activities. These may be new locations and/or utilizing non-system roads and they will be decommissioned when work is completed in the area that the access.

Temporary roads have the potential for direct short and mid-term impacts to aquatic indicators. Direct negative short and mid-term impacts would result if these activities occur within a species habitat to riparian condition, habitat connectivity, individuals, and introduction of pollutants or aquatic invasive species that are similar to new road construction. Direct impacts to riparian condition include reduction riparian vegetation cover or structure removal of vegetation which are components of gartersnake critical

habitat as well as some aquatic macroinvertebrate species habitat. Reduction in canopy cover could subsequently lead to localized increases stream temperature. The number of stream crossings could also increase which can fragment habitat unless they allow for fish passage and lead to increased sedimentation from streambank damage. Harm could potentially occur to individual site specifically at stream crossings or within riparian areas. Associated ground disturbance and increased sedimentation delivery to riparian areas and streams is expected to occur short to mid-term until the roads were decommissioned. Design features for limiting stream crossings, not creating new temporary roads in Aquatic Management Zones, and reducing impacts of crossings on existing temporary roads are expected to minimize the potential impacts discussed above.

Indirect negative impacts of opening temporary roads in the upper watershed could also occur to riparian condition. In general, roads compact soils and reduce infiltration of water leading to increased erosion and runoff. They increase the drainage network to riparian areas and streams and connect these areas to the uplands by altering surface water pathways. This converts dispersed surface runoff and sediment filtering through a riparian area to direct deliveries of accumulated runoff and sediment. Decreases in riparian condition from increased in peak flows and sedimentation could occur, but would vary based on their current condition.

Pollutants and aquatic invasive species can be introduced directly or indirectly to aquatic systems from machinery or vehicles creating or using temporary roads. Pollutants in the form of fuels and lubricants have the potential to be introduced into aquatic systems from staging areas and equipment. Spills and leaks can introduce pollutants to soils and then to streams and riparian areas reducing riparian condition and habitat quality. Design features for storm water protections plans, staging areas, fuel storage and checking equipment for leaks minimizes the potential for introduction of pollutants. Aquatic invasive species can similarly be transferred from an infected water body to an uninfected waterbody through driving or placement of materials from an infected source. However, design features for decontamination of equipment and not transferring water are expected to minimize potential introduction or spread of invasive species.

Long term, potential direct and indirect negative impacts of temporary roads would cease as roads were decommissioned and revegetated. Therefore, long term effects are considered neutral to aquatic resource indicators. Overall, the potential short and mid-term negative impacts of temporary roads would be more than Alternatives 1 and 3.

Sensitive Species not Covered by Resource Indicators and Measures

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles have diverse diets and feeding strategies, occupy different trophic levels and functional feeding groups from predators to filter feeders. Nymphs of the four groups are aquatic while adults stay in the riparian areas for reproduction.

Caddisflies are one of the largest groups of aquatic insects and are adapted to a wide range of microhabitats. Larval caddisflies have very diverse diets and feeding strategies, and occupy different trophic levels and functional feeding groups, including predators and filter feeders. Larvae are mainly herbivorous scavengers, feeding mainly on plant fragments and other living and dead organisms. Functionally, they can be collectors, shredders, scrapers, and predators. Feeding strategies may vary seasonally depending on items available and size of the caddisfly larvae. The larvae of most caddisfly species can be found in a variety of benthic habitats, including temperate lakes, streams, and ponds. Larvae of some species can tolerate low oxygen concentrations. Habitats can include benthic areas of streams, both cool and warm, lakes, marshes, and ponds. Caddisfly larvae are adapted to species-specific water temperatures and velocities, mineral and pollutant concentrations, and sunlight exposure. Because

of this, many species can occur together in a single stream or river. Adult caddisflies are terrestrial, nocturnal, and hide in cool, moist habitats (e.g., riparian vegetation) during the day.

Mayflies are relatively primitive insects and exhibit a number of ancestral trails that were likely present in the first flying insects. Nymphs live primarily in streams under rocks, in decaying vegetation, or in sediments (substrate). Larval mayflies are mostly herbivores or detritivores feeding on algae, diatoms, or detritus but a few are predators. Adults do not feed, but stay near water for reproduction as eggs are laid in the water.

Net-winged midge larvae live in clean, cool, well-oxygenated rapid streams (cascades, rapids, waterfalls) attached to rocks or other smooth hard substrate. Adults usually stay in the riparian zone and are often seen resting on the undersides of leaves on riparian trees or on wet overhanging rock faces. Larvae are highly specialized scapers, grazing on periphyton and other organic matter on submerged rocks; diatoms are a major component of their diet.

Riffle beetles are frequent members of the invertebrate community of running water (streams). All species have aquatic larvae; some species adults are terrestrial but most are aquatic. Most species occur in well-aerated streams, but can occur on wave-washed lake shores. Little is known about the food of adults or larvae, but they appear to be collector-gathers and scrapers that feed chiefly on algae and detritus.

Based on the biology and ecology of these four groups of species, streams and riparian areas could have negative direct and indirect impacts from Alternative 2. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats leading to impacts as described for fish and gartersnake species above. Alternative 2 would potentially having long-term benefits from reducing the risk of uncharacteristic wildfire and reduced road densities.

Nokomis Fritillary is a sensitive species that utilizes meadows, seeps, and boggy streamside vegetation. Alternative 2 could have negative direct and indirect negative impacts to the species and its habitat. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats as described for fish and gartersnake species above. It could also reduce the availability of the butterflies host plant (*Viola nephrophylla*) short-term. Alternative 2 would potentially having long-term benefits from reducing encroachment into its habitat, reducing the risk of uncharacteristic wildfire and lowering road densities.

The California Floater was once present in Fossil Creek, West Clear Creek, and Upper Clear Creek and it is possible that it may still occur within Chevelon Creek below Chevelon Dam. Direct and indirect negative impacts could occur in two of the watersheds, while only indirect impacts would likely occur in Chevelon Creek and Fossil Creek. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats as described for fish and gartersnake species above. Alternative 2 would potentially having long-term benefits from reducing the risk of uncharacteristic wildfire and reduced road densities.

Alternative 3 (Focused Alternative)

Direct and Indirect Effects - Alternative 3

Mechanical Vegetation Treatments

For Alternative 3, acres of mechanical vegetation treatments has the potential for negative short and mid-term impacts to riparian condition and individuals. Direct negative short term impacts would result during mechanical operations if these activities occur in a species habitat from yarding, skidding, or harm to gartersnakes. Alternative 3 is proposing treatments in the habitats of seven fish species and both gartersnakes. Increases in acreage of treatments ranges from 566 to 4,881 which equates to 19% - 100% of the analysis area for direct effects for those species. The two gartersnakes have the highest percentage of potential area impacted. Five fish species will not be directly impacted by mechanical vegetation treatments under Alternative 3. Table 37 displays this information for each species.

Table 38. Change by species in the acres of mechanical vegetation treatments for Alternative 3 as compared to Alternative1. Percentages reflect changes in acreages within species direct effects analysis areas.

Species	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 3: Acre of Mechanical Vegetation Treatment Acres/ Percentage of Direct Effects Area
Gila trout	0	1,319/ 49%
Gila chub	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	0	4,881/ 36%
Loach minnow	0	0/ 0%
Razorback sucker	0	0/ 0%
Spikedace	0	0/ 0%
Narrow-headed gartersnake	0	2,040/ 92%
Northern Mexican gartersnake	0	1,196/ 100%
Desert Sucker	0	3,744/ 28%
Sonoran Sucker	0	566/ 38%
Little Colorado sucker	0	2,986/ 23%
Headwater chub	0	1,806/ 52%
Roundtail chub	0	1,180/ 19%

Mechanical vegetation treatments can negatively impact riparian condition short to mid-term when they occur within the direct effects analysis area. Direct impacts of reduced riparian vegetation cover or structure could occur by removal of trees or crushed by machinery. These are also direct impacts to gartersnake critical habitat as well as habitat for some aquatic macroinvertebrates species. Indirect impacts of increased stream temperature from loss of canopy cover could occur, but should be limited based on design features associated with providing for and protection of existing stream shade. Indirect impacts of ground disturbance and increased sediment delivery to streams is expected to occur short to mid-term until ground cover is reestablished. Stream banks can be also be damaged, which are primary constituent element for some fish, however design features for mechanical vegetation treatments including restrictions for skid trails and yarding within riparian areas as well as protecting stream banks would minimize potential impacts.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore direct impacts are expected to be higher. Vegetation in these systems is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. Riparian

condition for the remaining species is functioning at risk, therefore direct and indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and functioning at some level.

Impacts to individuals in the form of harm or modification of behavior could also occur short to mid-term. Mechanical vegetation treatments within gartersnake habitat could result in harm of individuals as a direct effect. Gartersnakes may avoid or move out of these areas while work is occurring causing displacement or disruption of social and feeding behavior. This could potentially reduce the health or reproductive capability of individuals.

Long term, mechanical vegetation treatments could have a neutral or positive effect on aquatic indicators. Riparian condition could be improved by removing encroachment and restoring streamside vegetation. Conifers can impede the growth the riparian woody and herbaceous species; therefore it is expected they would increase in cover and structure. This would provide for large woody debris over time as well as decreasing sediment delivery and peak flows. Impacts to individuals would cease once activities were completed and therefore have a neutral effect long term.

For Alternative 3, increased acres of mechanical vegetation treatments as compared to Alternative 1 also has the potential for indirect occur short to mid-term impacts to riparian condition from treatments in the upper watershed. These are indirect impacts that can occur within a species action area (i.e., project watershed area that drains into a species occupied habitat) by changes in the uplands and on tributaries and drainages. For Alternative 3 the increases in percentage of action areas treated range from 11% to 68%. Headwater chub and Gila trout have the highest percentage of potential area impacted. Table 38 displays these species habitats as compared to Alternative 1. Five species have increases of 11%, but it is important to note the overall acreage is comparatively small due to approximately half of the overall watersheds occurring within the project area.

Table 39. Change by species in acres of mechanical vegetation treatments for Alternative 3 as compared to Alternative 1 within the species action area. Percentages reflect changes in acreages within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 3: Mechanical Vegetation Treatment Acres/ Percentage of Action Area
Gila trout	0	71,921/ 65%
Gila chub*	0	2,489/ 11%
Gila topminnow*	0	1,327/ 11%
Little Colorado spinedace	0	121,836/ 44%
Loach minnow*	0	1,327/ 11%
Razorback sucker*	0	1,327/ 11%
Spikedace*	0	1,327/ 11%
Narrow-headed gartersnake	0	41,711/ 47%
Northern Mexican gartersnake	0	31,051/ 64%
Desert Sucker	0	169,502/ 54%
Sonoran Sucker	0	30,623/ 59%
Little Colorado sucker	0	95,251/ 42%
Headwater chub	0	97,295/ 68%
Roundtail chub	0	82,835/ 52%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Mechanical vegetation treatments in uplands can indirectly impact riparian condition short to mid-term from increased sediment delivery and peak flows via removal of vegetation and ground disturbance. Soils can be compacted and water infiltration reduced from landings and skid trails leading to increased overland flow and erosion. Yarding and skidding can redirect water onto areas more likely to erode than natural channels. In turn, increased sedimentation and peak flows can occur reducing riparian condition, aquatic habitat quality and quantity.

Potential indirect effects are expected to vary based on current riparian condition. Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more would reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently functioning at risk, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Upper Fossil Creek is functioning properly. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows.

For those species with impaired or functioning at risk riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Design features related to mechanical vegetation treatments are expected to minimize the potential effects described above. The project includes spreading treatments in time and space within a watershed as well as for skid trails, yarding, and landings are expected to reduce these impacts.

Pollutants in the form of fuels and lubricants have the potential to be introduced into aquatic systems from staging areas and equipment. Spills and leaks can introduce pollutants to soils and then to streams and riparian areas reducing riparian condition and habitat quality. Design features for storm water protections plans, staging areas, fuel storage and checking equipment for leaks minimizes the potential for introduction of pollutants.

Long term, mechanical vegetation treatments are expected to improve overall watershed condition as well as riparian condition. Moving forests towards desired conditions of more a healthy, resilient state will provide for improved watershed function over time. It will also reduce the risk of uncharacteristic wildfire which can greatly impact all resource indicators and reduce aquatic habitat quality, quantity and populations.

The direct and indirect negative impacts of Alternative 3 to resource indicators are expected to be higher than Alternative 1, but less than Alternative 2 due to fewer acres of treatment. However, Alternative 3 would have less potential improvement to riparian condition, watershed condition, and reduced risk of uncharacteristic wildfire than Alternative 2.

Prescribed Burning

For Alternative 3, acres of prescribed burning has the potential for negative short and mid-term impacts to riparian condition and individuals. Direct impacts would result if these activities occur in a species habitat from firelines, removal or reduction of vegetation due to burning or harm to gartersnakes. Alternative 3 is proposing treatments in the habitats of seven fish species and both gartersnakes.

Increases in acreage of treatments ranges from 623 to 8,819 which equates to 24% to 100% of the analysis area for direct effects for those species (Table 39). The two gartersnakes have the highest percentage of potential area impacted. Five fish species will not be directly impacted by prescribed burning under Alternative 3.

Prescribed burning can negatively impact riparian condition short to mid-term when it occurs in the direct effects analysis area. Direct impacts of reduced riparian vegetation cover or structure and decreases in large wood recruitment could occur from burning. Decreases in willows and other shrubby species reduces hiding and thermal cover for gartersnakes. This would be a direct alteration of gartersnake critical habitat as well as potentially impacting some aquatic macroinvertebrate species. This reduction is only expected to occur until vegetation recovers. Reduction in canopy cover also reduces stream shading and can increase stream temperatures. It also reduces organic matter inputs to streams which can alter food webs and prey base for fish and gartersnakes. Indirect impacts of increased stream temperature from loss of canopy cover could also occur, but should be limited based on design features associated with limiting high burn severity (mortality) within riparian areas.

Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore direct and indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. They already lack adequate streamside cover and structure, therefore those factors could be more susceptible to impacts. Riparian condition for the remaining species is functioning at risk, therefore direct and indirect effects are expected to be less as they have more cover and structure. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present.

Long term effects of prescribed burning are expected to be positive for riparian condition. Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future. Large woody debris recruitment and streamside cover or structure can also improve with prescribed fire. Fire plays an important role in maintaining heterogeneity in riparian and aquatic systems that has been excluded similar to surrounding uplands (Gresswell 1999); therefore, restoring the fire regime would have some benefits to riparian condition.

Impacts to individual gartersnakes in the form of mortality or modification of behavior could also occur short to mid-term. Mortality could occur during prescribed burning; however, gartersnakes are mobile and design features of no burn piles within their habitat reduces that potential. While gartersnakes are more susceptible to exposure during a prescribed fire, it is more likely that harm or displacement would occur until the burns were completed. Long term impacts to individuals would be neutral or potentially positive if habitat improved and similarly increased social or feeding behavior.

Table 40. Change by species in the acres of prescribed burning for alternative 3 as compared to alternative 1. Percentages reflect changes in acreages within species direct effects analysis areas.

Species	Alternative 1: Acres of Prescribed burning	Alternative 3: Acres of Prescribed Burning/ Percent of Direct Effect Area
Gila trout	0	1,462/ 54%
Gila chub	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	0	8,819/ 65%
Loach minnow	0	0/ 0%
Razorback sucker	0	0/ 0%
Spikedace	0	0/ 0%

Species	Alternative 1: Acres of Prescribed burning	Alternative 3: Acres of Prescribed Burning/ Percent of Direct Effect Area
Narrow-headed gartersnake	0	2,211/ 100%
Northern Mexican gartersnake	0	1,196/ 100%
Desert Sucker	0	4,395/ 33%
Sonoran Sucker	0	623/ 42%
Little Colorado sucker	0	6,244/ 48%
Headwater chub	0	1,957/ 56%
Roundtail chub	0	1,470/ 24%

Short to mid-term negative indirect impacts from prescribed burning in uplands can occur within a species action area (i.e., watershed area that drains into a species occupied habitat) for all analyzed species. For Alternative 3 the increases in percentage of action areas treated range from 11% to 100%. However, while the five species (denoted with an asterisk) show increases, it is important to note the overall acreage is small. Table 40 displays these species habitats as compared to Alternative 1. Impacts would be highest for both Narrow-headed gartersnake and lowest for four species in Fossil Creek outside the project area.

Prescribed burning can indirectly impact riparian condition short to mid-term from increased sediment delivery and peak flows. Loss of ground cover from burning can increase erosion and overland flow which leads to increased sedimentation and peak flows. This could reduce riparian condition, aquatic habitat quality and quantity. However, these impacts are only expected to occur until ground cover vegetation recovers and has the ability to dissipate flows and trap sediment. Design features for extent of high burn severity as well as spatial and temporal spacing of activities within a watershed are expected to minimize potential impacts.

Potential indirect effects from increased peak flows and sedimentation are expected to vary by riparian condition. Indirect effects are expected to be higher for the four species with riparian condition that is currently impaired. Vegetation in these systems is not adequate to capture or process sediment, indicating more could potentially reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently functioning at risk, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Fossil Creek is functioning properly. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows. Overall acres of treatment for Gila chub, loach minnow, spikedace, razorback sucker, and Gila topminnow are less than half of the watersheds in which they occur further reducing potential indirect effects. Additionally, prescribed burning would only occur in the upper watershed within the project area.

For those species with impaired or functioning at risk riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Potential reductions in fish prey base could also indirectly impact gartersnakes. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Long term effects of prescribed burning in the upper watersheds are expected to be positive for riparian condition. Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future that can impact entire watersheds and have long lasting negative impacts on riparian condition, aquatic habitat quality and quantity, as well as populations of species.

Overall, Alternative 3 would have less potential direct and indirect impacts from prescribed burning than Alternative 2, but more than Alternative 1. This alternative would also not improve riparian condition as much as Alternative 2 nor reduce the risk of uncharacteristic wildfire across as many acres.

Table 41. Change by species in the acres of prescribed burning for alternative 3 as compared to alternative 1 within the species action area. Percentages reflect changes in acreages within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Acres of Prescribed burning	Alternative 3: Acres of Prescribed Burning/ Percentage of Action Area
Gila trout	0	79,480/ 72%
Gila chub*	0	2,492/ 12%
Gila topminnow*	0	1,328/ 11%
Little Colorado spinedace	0	140,659/ 51%
Loach minnow*	0	1,328/ 11%
Razorback sucker*	0	1,328/ 11%
Spikedace*	0	1,328/ 11%
Narrow-headed gartersnake	0	47/315/ 53%
Northern Mexican gartersnake	0	34,621/ 72%
Desert Sucker	0	190,190/ 60%
Sonoran Sucker	0	34,202/ 66%
Little Colorado sucker	0	113,047/ 50%
Headwater chub	0	106,923/ 75%
Roundtail chub	0	94,401/ 59%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Temporary Roads

For Alternative 3, up to 170 miles of temporary roads could be utilized to facilitate mechanical vegetation activities. These may be new construction and/or utilizing non-system roads and they will be decommissioned when work is completed in the area that the access.

Temporary roads have the potential for direct short and mid-term impacts to aquatic indicators. Direct impacts would result if these activities occur in a species habitat. Direct negative short and mid-term impacts could occur to riparian condition, habitat connectivity, individuals, and introduction of pollutants or aquatic invasive species that are similar to new road or trail construction. Direct impacts to riparian condition include reduction riparian vegetation cover or structure removal of vegetation. This would be a direct impact to gartersnake critical habitat as well as some aquatic macroinvertebrate species habitat. The number of stream crossings could also be increased causing a direct effect to fish as well as indirect impacts of increased sedimentation from streambank damage. Indirect impacts of increased stream temperature could also occur from reduction in canopy cover within riparian areas. Associated ground disturbance and increased sedimentation delivery to riparian areas and streams is expected to occur short to mid-term until the roads were decommissioned.

Indirect impacts of opening temporary roads in the upper watershed could occur to riparian condition and by introduction of pollutants or invasive aquatic species. In general, roads compact soils and reduce infiltration of water leading to increased erosion and runoff. They increase the drainage network to riparian areas and streams and connect these areas to the uplands by altering surface water pathways. This converts dispersed surface runoff and sediment filtering through a riparian area to direct deliveries of accumulated runoff and sediment. Pollutants and aquatic invasive species can be transferred to aquatic systems from machinery or vehicles. Leaking fuels or lubricants can be transferred to aquatic systems from vehicles, machinery, or fuel storage areas. Aquatic invasive species can similarly be transferred from an infected water body to an uninfected waterbody through driving. All of these impacts could occur and continue while the temporary roads were in use and continue for a short period of time after decommissioning.

Long term, temporary roads would be decommissioned and revegetate. Therefore, direct and indirect effects would cease. Therefore, long term effects are considered to be neutral.

The direct and indirect negative impacts of temporary roads would be more than Alternative 1, but less than alternative 2.

Sensitive Species not Covered by Resource Indicators and Measures

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles are strongly associated with streams and riparian areas. Based on the biology and ecology of these four groups of species, streams and riparian areas could have negative direct and indirect impacts from Alternative 3, but less than Alternative 2. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats as described for fish and gartersnake species above.

Nokomis Fritillary is a sensitive species that utilizes meadows, seeps, and boggy streamside vegetation. Alternative 3 could have negative direct and indirect negative impacts to the species and its habitat, but less than Alternative 2. Acres of riparian, grassland, and meadow treatments are the same between Alternatives 2 and 3, therefore direct impacts would be the same. Acres of upland mechanical treatments, prescribed fire, and miles of temporary roads are reduced in Alternative 3 leading to decreased indirect impacts. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats utilized by these sensitive species.

The California Floater was once present in Fossil Creek, West Clear Creek, and Upper Clear Creek and it is possible that it may still occur within Chevelon Creek below Chevelon Dam. Direct and indirect negative cumulative impacts could occur in two of the watersheds, no direct impacts would occur in Fossil Creek or Chevelon Creek. Increases in mechanical vegetation treatments, prescribed burning, and roads could increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats short- and long-term.

For all sensitive aquatic macroinvertebrates, streams and riparian areas could have negative direct and indirect impacts from Alternative 3, but less than Alternative 2 given the decrease in acres treated. Direct and indirect negative impacts for road use, relocation and decommissioning would be the same for both Alternative 2 and 3. Direct and indirect impacts from temporary roads would be less in Alternative 3 than Alternative 2 given the reduction in proposed miles. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats that negatively impact these sensitive species as described for fish and gartersnake species above.

Alternative 3 would potentially having long-term benefits from reducing the risk of uncharacteristic wildfire and reduced road densities.

Actions Common to Alternative 2 and 3

Opening ML-1 Roads

For Alternatives 2 and 3, it is assumed that all 5,682 miles of existing Forest Service roads within the project area will be utilized to provide access for removal of forest projects generated from the proposed mechanical vegetation activities as well as for other activities (Table 41). This includes temporarily opening all existing closed roads (ML-1) to utilize them for the time period that they are needed to provide access. These roads shall be closed upon completion of work and returned to a closed status (ML-1). For further explanation see the transportation specialist report (Rich 2018).

Table 42: Change miles of open Forest Service roads treatments for Alternatives 2 & 3 as compared to Alternative 1 within the project area.

Maintenance Level	Alternative 1 Total Open Road Miles	Alternative 2 & 3 Open Road Miles
1- Basic Custodial Care (closed)	0/ 0	2,076
2 - High Clearance	2,864	2,864
3 - Suitable for Passenger Vehicles	669	669
4 - Moderate Degree of User Comfort	71	71
5 - High Degree of User Comfort	2	2
Total System Roads	3,606	5,682

Opening of ML-1 roads has the potential for direct short and mid-term impacts to aquatic indicators. Direct impacts would result if these activities occur in a species habitat. Both Alternatives are proposing treatments in the habitats of nine fish species and both gartersnakes (Table 42). Increases in miles of open roads ranges from 21% to 127% of the analysis area for direct effects for seven species. The five species that occur downstream of the project have no increases in open roads within their direct effect analysis areas. Increases in road mileage are related to opening ML-1 roads within the direct effects analysis area. Little Colorado spinedace and roundtail chub have the largest increases in mileage; while headwater chub has no change in mileage in relation to direct impacts. Therefore Alternatives 2 and 3 would result in more potential direct impacts by increasing road density than Alternative 1.

Opening ML-1 roads can cause negative short and mid-term impacts to riparian condition, habitat connectivity, individuals, and introduction of pollutants or aquatic invasive species that are similar to new road or trail construction. Direct impacts to riparian condition include reduction riparian vegetation cover or structure removal of vegetation. This would be a direct impact to gartersnake critical habitat as well as some aquatic macroinvertebrate species habitat. The number of stream crossings could also be increased causing a direct effect to fish as well as indirect impacts of increased sedimentation from streambank damage. Indirect impacts of increased stream temperature could also occur from reduction in canopy cover within riparian areas. Associated ground disturbance and increased sedimentation delivery to riparian areas and streams is expected to occur short to mid-term until the roads were closed.

Table 43: Change by species in miles of open Forest Service roads for Alternative 2 &3 as compared to Alternative 1. Percentages reflect changes in acreages within species direct effects analysis areas.

Species	Alternative 1: Miles of Open Forest Service Roads	Alternative 2 & 3: Miles of Open Forest Service Roads/ Percent Increase
Gila trout	7	9/ 26%
Gila chub	0	0
Gila topminnow	0	0
Little Colorado spinedace	18	41/ 121%
Loach minnow	0	0
Razorback sucker	0	0
Spikedace	0	0
Narrow-headed gartersnake	7	9/ 29%
Northern Mexican gartersnake	4	5/ 25%
Desert Sucker	23	45/ 90%
Sonoran Sucker	6	7/ 21%
Little Colorado sucker	18	40/ 114%
Headwater chub	13	13/ 0%
Roundtail chub	5	12/ 127%

Indirect impacts to riparian condition and introduction of pollutants could occur from opening ML-1 roads in upper watersheds for all analyzed species (Table 43). Increases in miles of open roads range from 4% to 115%. Narrow-headed gartersnake and Sonoran sucker have the largest increases in road mileage. Gila chub and the four species in Fossil Creek (Gila topminnow, Loach minnow, Razorback sucker, and Spikedace) have the lowest increases in open road mileage since only a portion of those subwatersheds are within the project area. Alternatives 2 and 3 would have more direct impacts from opening ML-1 roads within species action areas than Alternative 1.

Table 44: Change by species in miles of open Forest Service roads for Alternative 2 &3 as compared to Alternative 1. Percentages reflect changes in acreages within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Miles of Open Forest Service Roads	Alternative 2 & 3: Miles of Open Forest Service Roads/ Percent Increase
Gila trout	232	324/ 40%
Gila chub*	61	63/ 4%
Gila topminnow*	63	70/ 11%
Little Colorado spinedace	917	1768/ 93%
Loach minnow*	63	70/ 11%
Razorback sucker*	63	70/ 11%
Spikedace*	63	70/ 11%
Narrow-headed gartersnake	170	372/ 119%
Northern Mexican gartersnake	86	142/ 65%
Desert Sucker	1034	1439/ 39%
Sonoran Sucker	112	240/ 115%
Little Colorado sucker	796	1412/ 77%
Headwater chub	354	438/ 24%

Species	Alternative 1: Miles of Open Forest Service Roads	Alternative 2 & 3: Miles of Open Forest Service Roads/ Percent Increase
Roundtail chub	475	907/ 91%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Indirect impacts of opening ML-1 roads in the upper watershed could occur to riparian condition and by introduction of pollutants or invasive aquatic species. In general, roads compact soils and reduce infiltration of water leading to increased erosion and runoff. They increase the drainage network to riparian areas and streams and connect these areas to the uplands by altering surface water pathways. This converts dispersed surface runoff and sediment filtering through a riparian area to direct deliveries of accumulated runoff and sediment. Pollutants and aquatic invasive species can be transferred to aquatic systems from machinery or vehicles. Leaking fuels or lubricants can be transferred to aquatic systems from vehicles, machinery, or fuel storage areas. Aquatic invasive species can similarly be transferred from an infected water body to an uninfected waterbody through driving.

Roads not only impact perennial and intermittent streams where aquatic species and riparian areas are present, but influence these habitats where they are located adjacent to or cross ephemeral channels in the watershed. Ephemeral streams indirectly support aquatic populations by providing required nutrients and other materials to the perennial streams (Levick et al. 2008).

Potential indirect effects are expected to vary based on current riparian condition. Species with riparian conditions that are currently impaired are expected to have a higher level of indirect effects from sedimentation and peak flows. They are currently not capturing or processing sediment, indicating more could potentially reach stream from direct delivery. Stream energy from increased peak flows and concentrated flows would not be dissipated potentially altering instream habitats. Riparian areas that are functioning at risk or functioning properly would be capable of processing some levels of sediment and peak flows; however, the concentrated delivery from roads would still have negative impacts over the mid-term timeframe until they were closed.

Opening ML-1 roads will also increase road density during the timeframe that proposed project activities are occurring. This will negatively impact the Roads and Trails indicator for Watershed Condition Framework in the interim impacting one of the five factors associated with aquatic species and habitats.

Design features for roads are expected to reduce some of the potential impacts to aquatic species and habitats. Minimizing disturbance of existing vegetation in ditches and at stream crossings during maintenance. New cross drains will discharge to stable areas where the outflow will quickly infiltrate the soil and not develop a channel to a stream. Whenever possible, use existing stream crossings unless a new crossing would result in less resource damage.

In Woods Processing Sites (IWPS) and Biomass Storage

Thirteen processing sites ranging in size from 2 to 21 acres are being proposed on the Coconino and Tonto NFs and analyzed for environmental effects for both Alternative 2 and 3 of Rim Country (Table 44). Processing site location and siting considerations include: flat uplands less than 5% slope; more than 200 feet from perennial, intermittent, and ephemeral stream channels/ more than 300 feet from meadows, springs, and karst features; more than ¼ mile from Mexican spotted owl Protected Activity Centers, and outside of Northern goshawk Protected Family Areas; more than ¼ mile from system hiking trails,

campgrounds, and group event recreation sites; more than ¼ mile from private lands, residences, or offices; and adjacent to roads that are open year-round for product removal. Processing sites were located to provide a buffer of 100 to 300 feet from forest roads and state highways to provide for visual screening from Concern Level 1 and 2 travelways. Site boundaries are approximate and may be further modified during implementation and layout.

The processing of wood at up to eight different sites within or immediately adjacent to the project area may involve such tasks as drying and debarking of logs; chipping stems, bark, and limbs; cutting logs; sorting logs; producing wood cants (logs sawn flat on one to four sides); scaling and weighing logs; and creating poles from suitable sized logs. Equipment that may be used at processing sites includes circular or band saws, various sizes and types of front-end loaders, log loaders, chippers of several types, mechanized cut to length systems, associated conveyers and log sorting bunks for accumulation and storage of logs, as well as electric motors and gas or diesel generators to provide power. Aboveground fuel storage tanks may be necessary to provide on-site fuel to equipment.

The eight wood processing sites that have been proposed range in size from 4 to 21 acres. These sites were screened so as to be located outside of meadows where some of the most productive forest soils are found, and in relatively flat areas. The siting of processing sites in relatively flat areas would minimize the need for extensive site grading.

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

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

Table 45. In Woods Processing Sites and associated acreages.

Site Name	Acres
FR 117, 1321	4
FR 137, 96	18
FR 139, 9729D	14
FR 145A, 9615X	7
FR 288, 2781	4
FR 294, 294D	18
3238, 512	20
FR 582, Hwy 87	5
FR 609, 1938	7
FR 74, 64	8
FR 81, 81E	7
9364L, FH 3	21
9731G, Hwy 87	9

Site Name	Acres
Total (13)	142

No direct effects to any aquatic indicators are expected to occur from IWPS (Table 45). None of the proposed IWPS occur within 0.4 mile of occupied or suitable habitat. In addition, they occur within conifer ERUs (Ponderosa Pine, Ponderosa Pine-Evergreen Oak, Mixed Conifer w/ Aspen, and Mixed Conifer) and not within any riparian areas.

Table 46. Change by species in the acres of In Woods Processing sites for Alternatives 2 & 3 as compared to Alternative1. Percentages reflect changes in acreages within species direct effects analysis areas.

Species	Alternative 1: Acres of In Woods Processing	Alternatives 2 &3: Acre of In Woods Processing/ Percentage of Direct Effects Area
Gila trout	0	0/ 0%
Gila chub	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	0	0/ 0%
Loach minnow	0	0/ 0%
Razorback sucker	0	0/ 0%
Spikedace	0	0/ 0%
Narrow-headed gartersnake	0	0/ 0%
Northern Mexican gartersnake	0	0/ 0%
Desert Sucker	0	0/ 0%
Sonoran Sucker	0	0/ 0%
Little Colorado sucker	0	0/ 0%
Headwater chub	0	0/ 0%
Roundtail chub	0	0/ 0%

Indirect impacts from IWPS have the potential to occur to seven of the species based on their action areas. Two species (Gila trout and Sonoran Sucker) would have no indirect impacts. Acreages of IWPS range from 3.1 to 57.4 acres for both gartersnakes and desert sucker, respectively (Table 46). Negative indirect impacts to riparian condition in the form of sedimentation are possible, but limited based on less than 0.5% of any species action area being impacted. In Woods Processing Sites would also have limited negative impacts to aquatic macroinvertebrates based on the very low percentage of IWPS acreage in any of the subwatersheds. For California floater, only two watersheds have the potential for any indirect impacts, with a total of approximately 72 acres of IWPS within those watersheds. The other aquatic macroinvertebrates share similar stream and riparian habitats with fish and gartersnakes; therefore, overall acreages of IWPS are still below 1% combined.

The Apache-Sitgreaves NFs do not have any of the identified IWPS listed above; instead they will allow biomass (needles, tree tops and branches up to 5 inches) waiting to be processed to remain on forest during mechanical operations for up to 90 days. The timeframe allowed may be shortened based on conditions such as fire risk preparedness levels.

Allowing biomass to stay on the Apache-Sitgreaves Forest should not directly impact aquatic species or habitats, but could have indirect impacts. Piling of any kind is not allowed within Aquatic Management

Zones; therefore this action should not have any direct effects. Indirect effects could include soil disturbance from machinery moving material to and from the piles as well as hauling. Soil disturbance can lead to erosion and contribute fine sediment to streams negatively impacting aquatic habitat, species, and water quality; particularly eggs and early life stages that occur on or within substrate and aquatic macroinvertebrate community structure. Habitat can be negatively impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Excessive fine sediment can impact macroinvertebrate prey bases and other food sources such as algae.

Similarly, leaving biomass should not directly impact sensitive invertebrates, but could have direct impacts. For aquatic invertebrate species, increased fine sedimentation can lead to physical effects as well as changes in habitat and food availability and quantity. Physical effects include abrasion, clogging of gills and filter-feeding apparatus, burial, and changes in substrate composition (Jones et al. 2012). Bivalve mollusks, such as California floater, are capable of expelling unwanted particles from their gulls but can also expend more energy doing so than is gain from feeding. Filter feeding caddisfly larvae are generally not present in streams receiving high inputs of fine sediment. Burial presents difficulties for sedentary animals, such as mollusks, but can affect motile invertebrates where rates of deposition are high. When inputs of fine sediment are increased in watersheds, interstices between large particles become filled which reduces refugia from predators or high-flow events. Most aquatic invertebrates are strongly associated with substrate composition; therefore increased fine sediment can alter habitat availability. Increased sedimentation can also decrease the nutritional quality of periphyton (the film of attaches algae, fungi, bacteria, organic matter, and sedimented material found on the surface of stones). Some caddisflies, stoneflies, and mayflies are particularly impacted by sedimentation (Harrison et al. 2007).

Table 47. Change by species in the acres of In Woods Processing Sites for Alternatives 2 & 3 as compared to Alternative1. Percentages reflect changes in acreages within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Acres of In Woods Processing	Alternatives 2 & 3: Acre of In Woods Processing/ Percentage of Direct Effects Area
Gila trout	0	0/ 0%
Gila chub	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	0	25.7/ 0.01%
Loach minnow	0	0/ 0%
Razorback sucker	0	0/ 0%
Spikedace	0	0/ 0%
Narrow-headed gartersnake	0	3.1/ 0%
Northern Mexican gartersnake	0	3.1/ 0.01%
Desert Sucker	0	57.4/ 0.02%
Sonoran Sucker	0	0/ 0%
Little Colorado sucker	0	25.7/ 0.01%
Headwater chub	0	8.5/ 0.01%
Roundtail chub	0	38.5/ 0.02%

In Woods Processing Sites could have negative short and mid-term indirect impacts to riparian condition similar to landings. In general, soils can be compacted and water infiltration reduced leading to increased runoff and sediment delivery to riparian areas and streams. This can reduce riparian condition, aquatic habitat quality and quantity depending on its current condition.

Potential indirect effects are expected to vary based on current riparian condition. Riparian condition for both gartersnakes, desert sucker and Sonoran sucker are currently impaired, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more would reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently functioning at risk, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Upper Fossil Creek is functioning properly. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows.

For those species with impaired or functioning at risk riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Potential indirect impacts of IWPS and biomass storage could occur short and mid-term. However, given the low overall acreage within species action areas, indirect effects are considered to be minimal.

Rock Pit Development or Expansion

In order to provide adequate sources of road surfacing material, rock pits will be need to be utilized and expanded within the project area. Eleven existing pits on are proposed for expansion. In order to allow for potential future material needs, all pits are proposed for a 30% expansion of their current foot print. Current acreage and proposed future acreage are shown in Table 47.

Table 48. Current acreage of proposed rock pits for use and proposed acreage pit expansion.

Pit Name	Current Acreage	Increase in Acreage	Possible Future Acreage
34T	5	2	7
213	7	2	9
Pias Farm	6	2	8
115	7	2	9
717E	2	1	3
34B	5	2	7
Promontory	16	5	21
Carr Lake	12	4	16
Brookbank	1	1	2
Borrow	12	4	16
Cottonwood Wash	6	2	8
Total	**98**	**33**	**131**

No direct effects to any aquatic species or habitats are expected to occur from Rock Pit use or expansion. Table 48 displays this information. None of the proposed rock pits occur within ½ mile of occupied or suitable habitat. In addition, they occur within conifer ERUs (Ponderosa Pine, Mixed Conifer w/ Aspen, and Mixed Conifer) which are not utilized by sensitive invertebrate species, therefore no direct impacts would occur.

Table 49. Change by species in the acres of existing rock pits sites and their expansion for Alternatives 2 & 3 as compared to Alternative 1. Percentages reflect changes in acreages within species direct effects analysis areas.

Species	Alternative 1: Acres of Rock Pits	Alternative 2 &3: Acre of Rock Pits/ Percentage of Direct Effects Area
Gila trout	0	0/ 0%
Gila chub	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	0	0/ 0%
Loach minnow	0	0/ 0%
Razorback sucker	0	0/ 0%
Spikedace	0	0/ 0%
Narrow-headed gartersnake	0	0/ 0%
Northern Mexican gartersnake	0	0/ 0%
Desert Sucker	0	0/ 0%
Sonoran Sucker	0	0/ 0%
Little Colorado sucker	0	0/ 0%
Headwater chub	0	0/ 0%
Roundtail chub	0	0/ 0%

Indirect impacts from rock pit use and expansion within the upper watershed have the potential to occur to six of the species. Three species (Gila trout, Sonoran Sucker, and Desert Sucker) would have no indirect impacts. Acreages of rock pits within species action areas range from 4.6 to 200.6 acres (Table 49). Little Colorado spinedace and sucker have higher acreages of Rock Pits versus all other species. Overall, potential negative impacts are limited based on less than 1% of any species action area being impacted.

Indirect impacts to aquatic macroinvertebrates could occur from Rock Pit use and expansion similar to fish and gartersnakes. For California floater, only Upper Clear Creek watershed has any rock pits, approximately 177 acres or less than 1% of that 5th Code watershed.

Negative indirect effects from rock pits could potentially occur to riparian condition. Expansion of the pits would result in removal of some additional vegetation (Table 41) and could lead to some increases in erosion and sedimentation. However, design features limiting vegetation removal, erosion control, and reclamation are expected to reduce the potential for any impacts to riparian condition.

Table 50. Change by species in the acres of existing rock pits sites and their expansion for Alternatives 2 & 3 as compared to Alternative 1. Percentages reflect changes in acreages within species analysis areas. These are considered indirect impacts.

Species	Alternative 1: Acres of Rock Pits	Alternative 2: Acre of Rock Pits/ Percentage of Action Area
Gila trout	0	0/ 0%
Gila chub	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	20	200/ 0.07%
Loach minnow	0	0/ 0%
Razorback sucker	0	0/ 0%
Spikedace	0	0/ 0%
Narrow-headed gartersnake	0	5/ 0.01%
Northern Mexican gartersnake	0	5/ 0.01%
Desert Sucker	0	5/ 0.00%
Sonoran Sucker	0	0/ 0%
Little Colorado sucker	0	103/ 0.05%
Headwater chub	0	5/ 0%
Roundtail chub	0	0/ 0%

Stream, Riparian, Wet Meadow, and Spring Restoration

Alternatives 2 and 3 includes restoration treatments to improve riparian areas, stream habitat, springs, wet meadows, and reduce upland erosion and excess sediment transport to streams. Approximately 628 miles of streams, 184 springs and 14,720 acres of riparian habitat have been identified for potential restoration activities. In addition, approximately 200 miles of protective barriers around springs, aspen, native willows, and big-tooth maples, as needed for restoration. Methods for stream restoration vary and specific treatments will be determined prior to implementation. The Aquatic and Watershed Flexible Toolbox Approach (AWFTA) outlines the potential treatments that are being analyzed (Appendix C).

Restoration of streams, riparian areas, springs, and wet meadows to improve stream habitat, stabilize stream channels and streambanks. There are categories of watershed and stream impairments that are common throughout the project area that may be appropriately addressed with a suite of restoration treatments, referred as “tools”, with predictable effects that can be analyzed as part of this project. Having a suite of tools available for restoration helps account for imperfect information and adjust treatments in a variety of existing conditions, enabling project implementers to find the best solutions for a site-specific problem. Tools that might be appropriate in one area (e.g., stream type) may not be the right tool somewhere else. This flexible toolbox approach provides the ability to adapt treatments to unanticipated conditions and applies to both Alternatives 2 and 3; the complete toolbox can be found in Appendix C. Prescribed burning, mechanical vegetation thinning, and roads work in the toolbox are analyzed and addressed as part of Alternatives 2 and 3.

Proposed stream restoration was categorized as either general stream treatments or heavy mechanical stream treatments based on the methods of implementation. General stream treatments are described as any methods in the AWFTA that do not involve heavy mechanical equipment in or near a stream. Examples would include methods such as: fencing, planting, tools for improving spring outflows, and Zuni bowls or one rock dams as described in the AWFTA. Heavy mechanical stream treatments are reflective of treatments such as, but not limited to, channel reconstruction, channel realignment, and floodplain reconnection. The majority of the heavy mechanical treatments are described in Appendix C under the heading “Tools for improving the form and function of stream channels and floodplains”.

General stream treatments could have direct and indirect impacts to aquatic indicators. Miles of proposed treatments range from 5 miles for Sonoran sucker to 179 miles for Little Colorado spinedace (Table 50). No direct or indirect impacts are expected to occur for 7 species as no treatments are proposed within their habitats, this includes both gartersnakes. The proposed activities are intended to enhance riparian and aquatic conditions at the site scale. All of these actions may result in some degree of short and mid-term negative effects to aquatic species and their habitats.

Direct effects to riparian condition would include ground disturbance reducing riparian vegetation cover or structure short to mid-term. Ground disturbance would lead to indirect impacts increased sedimentation during project implementation. These impacts are considered short-term (a few weeks) and sediment should be moved downstream during the first high stream flow. Beneficial impacts of general stream treatments can be immediate and long-term. Stabilizing headcuts has an immediate impact of stabilizing a stream and improving fish passage upstream. Riparian planting increases bank stability, shade, and organic matter inputs to streams improving stream habitat.

Table 51. Change by species in the miles of general and heavy mechanical stream restoration for Alternatives 2 & 3 as compared to Alternative 1. Percentages reflect changes in acreages within species analysis areas. These are considered direct and indirect impacts.

Species	Alternative 1	Alternatives 2 & 3: General Stream Treatment Miles/ Percentage of Action Area.	Alternatives 2 & 3: Heavy Mechanical Stream Treatment Miles/ Percentage of Project Area
Gila trout	0	7/ 22%	4/ 13%
Gila chub	0	0/ 0%	0/ 0%
Gila topminnow	0	0/ 0%	0/ 0%
Little Colorado spinedace	0	179/ 96%	24/ 13%
Loach minnow	0	0/ 0%	0/ 0%
Razorback sucker	0	0/ 0%	0/ 0%
Spikedace	0	0/ 0%	0/ 0%
Narrow-headed gartersnake	0	0/ 0%	0/ 0%
Northern Mexican gartersnake	0	0/ 0%	0/ 0%
Desert Sucker	0	51/ 48%	18/ 17%
Sonoran Sucker	0	5/ 37%	3/ 26%
Little Colorado sucker	0	123/ 84%	14/ 10%
Headwater chub	0	9/ 19%	7/ 14%
Roundtail chub	0	23/ 66%	3/ 10%

Heavy mechanical stream treatments could have negative direct and indirect impacts to aquatic indicators. These treatments inherently include disturbance in streams, their floodplains, and associated riparian areas in order to improve form and function. Miles of proposed treatments range from 3 to 24 miles, which encompasses 10% to 26% of occupied habitats. No direct and indirect impacts are expected to occur for 7 species as no treatments and proposed within their habitats, this includes both gartersnakes. Sonoran sucker and Desert sucker have the highest percentage of occupied/suitable habitat within proposed heavy mechanical stream treatments.

Short-term direct impacts of heavy mechanical stream restoration could occur to individuals, while indirect impacts to riparian condition, introduction of contaminants, and spreading of aquatic invasive species or disease could occur during project implementation.

Direct impacts in the form of mortality could occur from heavy machinery in and around streams, springs and wetlands. These are considered short-term effects as they would only occur while heavy equipment was operating. Conservation measures to look for and move gartersnakes, remove and isolate fish from instream construction, and in water work periods are expected minimize the potential for direct impacts. In water work periods will be determined on a project specific basis and jointly by Forest Service, U.S. Fish and Wildlife Service and Arizona Game and Fish Department due to the overlapping of federally listed and sensitive species.

Short-term negative impacts of temporarily restricting habitat or habitat access (displacement) could occur during project implementation. Coffer dams and bypass systems associated with heavy mechanical restoration activities may temporarily block (few weeks) fish movement up and/or downstream through the construction area. Up and downstream fish movement is provided by ditch bypass systems, downstream movement is provided with plastic-culvert bypass systems, and no fish movement is provided with pump bypass systems. Headcuts and existing structures to be repaired may serve as exiting fish-passage barriers; therefore, coffer dams and diversion structures may not be any more of a barrier than the pre-restoration baseline.

Riparian condition could be negatively impacted short-term inputs of increased sedimentation from instream structure placement, opening of side channels, road crossing treatments, and other projects inside or near the bankfull channel. The sediment plume from activities will be most concentrated in the immediate project vicinity and should dissipate throughout the stream channel within a few hours. The amount, extent, and duration of fine sediment inputs and turbidity relate to the following: the type and duration of heavy machinery used within or near a bankfull channel; soil type; the amount of soil disturbance; whether restoration is in or out of the wetted channel; the sensitivity of the channel banks to erosion and other disturbances; the amount of time it takes for disturbed areas to revegetate and stabilize; and the probability of precipitation events before disturbed areas are re-vegetated or stabilized.

The increased stream turbidity may deposit fine coats of sediment on channel substrate a short distance downstream, encourage fish and other aquatic species to move downstream, and alter fish behavior patterns for a short time. It is anticipated that all project related sediment will be flushed out during the first fall/winter/spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term negative impacts to substrate are not expected.

Contaminants and aquatic invasive species or diseases could be introduced into the stream from large equipment causing negative indirect impacts to aquatic species. Chemical transport could be direct into streams from equipment or from storm water runoff through or over soil. Pollutants alter soil chemistry, may be absorbed by plants, can affect stream ecosystems, where they are dispersed and diluted over considerable distances. Typical water-quality responses to pollutants include altered levels of heavy metals, salinity, turbidity, and dissolved oxygen. These water quality changes can be sporadic and localized due to fluctuations in water quantity. Aquatic invasive species or diseases could similarly be introduced to streams or waterbodies. Best management practices and conservation measures requiring cleaning equipment, checking for leaks, storage of fuels, and staging areas for equipment of AMZs minimizes or precludes the likelihood of either occurring.

Benefits from heavy mechanical stream restoration can be immediate and long-term by improving or restoring riparian condition via one of the following: stream structure/complexity, stream sinuosity and

length, bank stability, floodplain connectivity. Such results will promote conditions that maintain or decrease stream temperature, reduce turbidity (via stable banks, improved sediment retention through increased channel structure, riparian areas, and floodplains), and improved nutrient input (via increases riparian organic input sources) and retention (via increased channel structure, sinuosity, and floodplain areas). It is anticipated that the project related sediment will be flushed out during the first spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term sediment impacts to sediment and turbidity are not expected.

Human constructed or caused physical barriers within the stream channel such as culverts and headcuts can impair sediment and debris transport, migration routes, life history patterns, and population viability. First and second order streams are the sources of water, nutrients, woods, another vegetative material for streams inhabited by fish and other aquatic organisms. Fish Passage Culvert Projects, Headcut stabilization and Associated Fish Passage, and Legacy Structure Removal treatments would result in benefits such as uninhibited stream access for migrating and rearing fish, restored or improved continuous paths for wood, nutrients, sediments, and other vegetative material essential for quality fish habitat.

Upland soil restoration structures (e.g. Zuni bowls or native rock check dams) may be used to address site specific erosion/channelization resource issues within project watersheds. The number that may be installed will vary based on watershed needs. These structures will have a long term benefit of reducing erosion and sedimentation to stream by holding and stabilizing soils in the uplands and improving hydrologic condition and function. Riparian and rare plant planting and enclosures to protect existing or planted areas could occur where site-specific needs are identified in riparian areas, wet meadows, springs, and uplands areas such as where aspen or big-toothed maple occur. Riparian planting and enclosures along streams can improve bank stability, stream shading and aquatic habitat.

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles are strongly associated with streams and riparian areas. Based on the biology and ecology of these four groups of species, stream and watershed restoration in accordance with the AWFTA could have negative direct and indirect impacts. Direct impacts to individuals and their habitats could occur short-term during project implementation. General stream treatments would have a low potential for direct and indirect impacts to these sensitive species given the methods included (e.g. fencing, planting). Heavy mechanical stream treatments have the potential for more direct effects as they include short-term habitat alteration in streams and riparian areas that could also impact individuals. Indirect effects of sedimentation from the AWFTA restoration treatments would last as long as the first few flushing flow events. Beneficial effects would occur from improved stream habitats and riparian vegetation long term.

Nokomis Fritillary is a sensitive species that utilizes meadows, seeps, and boggy streamside vegetation. General stream treatments would have a low potential for direct or indirect impacts to the species. Heavy mechanical stream treatments could have direct and indirect impacts. Short-term direct impacts to individuals and their habitat could occur during implementation. Indirect effects of habitat alteration would last until vegetation was restored or had regrown that supports the species. Beneficial effects would occur from improved stream-riparian interaction and riparian habitat.

For California Floater, general stream restoration treatments would have a low potential for direct or indirect impacts. Fencing across streams could directly impact the species, but is unlikely. Indirect impacts of sedimentation from these methods would also be considered negligible. Heavy mechanical stream treatments are proposed in Upper Clear Creek (49 miles) and West Clear Creek (2.9 miles) where the species historically or currently occurs. Short-term direct impacts would occur during implementation

of instream treatments that could also impact individuals. Indirect impacts of sedimentation are expected to persist until first few flushing flows mobilize any sedimentation downstream. Beneficial effects would occur from improved stream habitats long term.

For all sensitive aquatic macroinvertebrates, streams and riparian areas could have short-term negative indirect impacts from proposed stream restoration as part of Alternatives 2 and 3. Short-term indirect effects of heavy mechanical stream restoration include increased sedimentation and turbidity, introduction of contaminants, and spreading of aquatic invasive species or disease during project implementation. Project level best management practices and mitigations would minimize the potential for introduction of contaminants or spread of aquatic invasive species or disease.

Road Relocation and Decommissioning

Road relocation and decommissioning include restoring a road surface to a more natural state. Short-term negative impacts to individuals and riparian condition would be similar to those discussed above for aquatic restoration. Direct impacts to individuals could occur for any work within species habitats. Riparian condition could be negatively impacted short to mid-term by increased sediment delivery until vegetation reestablished.

However, long term benefits of reducing road density have a cascade of effects: improved riparian condition from reduction in runoff and sedimentation, fewer roads crossings, and the ability for riparian vegetation to be restored, and decreased mortality or disturbance of species. Road density is a major factor in the current condition of most subwatersheds with aquatic species in the project area. Reducing road density by decommissioning roads could help improve that particular Watershed Condition Framework indicator. Relocating roads does not reduce overall road density, but can alleviate direct versus indirect impacts, particularly if move a road further from a stream or riparian area.

Design features for road relocation are expected to reduce some of the potential impacts. Relocated roads should be constructed in a manner that does not hydrologically connect them to streams to extent practicable. They will also have sufficient drainage features to maintain the integrity of the travel, thereby reducing erosion and sedimentation. New cross drains will discharge to stable areas where the outflow will quickly infiltrate the soil and not develop a channel to a stream. When feasible, relocate roads out of drainage bottoms to upland locations; if this is not possible rock armor outfall of drainage features to dissipate water energy. Contaminants and aquatic invasive species or diseases could be introduced into the stream from large equipment causing negative indirect impacts to aquatic species. Chemical transport could be direct into streams from equipment or from storm water runoff through or over soil. Pollutants alter soil chemistry, may be absorbed by plants, can affect stream ecosystems, where they are dispersed and diluted over considerable distances. Typical water-quality responses to pollutants include altered levels of heavy metals, salinity, turbidity, and dissolved oxygen. These water quality changes can be sporadic and localized due to fluctuations in water quantity. Aquatic invasive species or diseases could similarly be introduced to streams or waterbodies. Best management practices and conservation measures requiring cleaning equipment, checking for leaks, storage of fuels, and staging areas for equipment of AMZs minimizes or precludes the likelihood of either occurring.

Cumulative Effects

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

The cumulative effects analysis geographic boundary is the Rim Country project area boundary as this area includes all actions associated with implementation for this analysis. The following list summarizes

the past, present, and future activities that would add to the total cumulative effects. Since the implementation of the Rim Country is so large, the activities will be discussed generally.

- *Timber Harvest and Vegetation Management:* These types of projects include timber harvest, vegetation treatments, fuel reductions and treatments, wildland urban interface treatments, salvage logging, energy corridor maintenance, and fuelwood harvesting. Past timber harvest activities have resulted in substantial impacts to watersheds, hydrologic conditions, riparian and aquatic habitat, and fish species across the proposed project area (especially in vegetated areas with high timber resources (e.g., ponderosa pine, mixed-conifer, spruce-fir, etc.). This activity has resulted in most of the existing transportation system present today, especially management level 1 and 2 roads. More recent vegetation treatments likely have had less impacts, but can still contribute cumulative effects, especially given resource conditions and ecological processes that have been highly altered from legacy impacts. Fuelwood collecting and harvesting is also a very widespread activity occurring across the project area. It occurs extensively within timber harvest areas, but also occurs as part of or within vegetation treatments in woodland areas as well. Projects such as Upper Beaver Creek, Larson, Rim Lakes, and Upper Rocky Arroyo have been occurring and will continue into the future; whereas CC Cragin is a future project.

- *Recreation and Recreation Management:* Recreational activities occur throughout the proposed project area, and are continuing to increase. Developed recreation sites, dispersed camping, hiking, fishing, hunting, driving, boating, wildlife viewing, and many other types of recreational activities occur across proposed project area. Riparian areas, lakes, and streams are very popular areas for recreational activities and dispersed camping; this can result in deteriorated resource conditions from the concentrated use (e.g. loss of vegetation and soil compaction), and can also impact water quality.

- *Fire Suppression and Fire Management Projects:* Fire suppression activities have been in place for decades, and have resulted in unnatural vegetative conditions and have altered ecological processes across most of the proposed project area. Suppression activities are ongoing and will continue well into the future, as vegetation structure and composition has been altered so that allowing it to burn will result in uncharacteristic and unacceptable resource impacts. Fire suppression activities can also impact water resources and species dependent upon them by removing water, which usually occurs during the driest part of the year. Prescribed fire and burns have been occurring for the last 10-20 years, and have increased considerably in their extent and impacts over the last 5-10 years. Fire management can have both short and long term impacts that are both positive and negative, and cumulatively these impacts will be dependent on the existing resource conditions and the future environmental conditions. It should also be noted that significant levels of wildfire activities have occurred across the proposed project area in the last 20-25 years, especially associated with large wildfires such as Rodeo-Chediski Fire (2002) that burned within the proposed project area.

- *Livestock Grazing:* Grazing livestock has likely occurred for over a century across the proposed project area. Historically unrestricted and unregulated resulted in overgrazing, especially within riparian areas, has likely contributed to the degraded riparian and aquatic habitat conditions that currently occur. Livestock grazing is continuing over most of the proposed project area, although some areas are excluded for resource recovery reasons. Infrastructure development and maintenance associated with livestock grazing allotments is substantial. Thousands of miles of fences and thousands of stock tanks occur throughout the proposed project area. Impacts to aquatic habitat and species, hydrologic conditions and processes, and riparian and upland conditions have occurred; and this will continue as long as livestock management and the

associated infrastructure remains in place, and contributes cumulative effects to aquatic species and their habitats.

- *Road and Trail Construction, Maintenance, and Closure:* As previously stated past timber activities and harvest primarily accounted for road development and placement, and this is still reflected in the existing transportation system. Approximately 5,682 miles of roads and almost many miles of hiking trails occur within Rim Country. While roads and trails are necessary for the use, enjoyment, and management, they also are responsible for considerable landscape scale changes to the functioning and maintaining of ecological processes and values. Maintenance activities for roads and trails are limited by available funding, and can result in both positive and negative benefits, depending on when it occurs and how often. These impacts will continue as long as the roads/trails are in place, and are a major contributor to cumulative effects. The Coconino NF has closed over 90 miles of roads as part of focused watershed restoration activities in the Little Colorado River watershed.

- *Special Uses and Permits/Minerals Management/Land Exchanges:* Hundreds of special uses permits have been issued across the proposed project area. These include permits for outfitter and guiding activities fuelwood and Christmas tree cutting, road easements, plant and minerals collection, church and youth camps, gravel and cinder pits, ditch bill easements, communications sites, and other uses as well. All of these activities can result in impacts to watersheds riparian areas, and aquatic habitat and species; and contribute to cumulative effects, especially water development and diversion projects. Land exchanges have resulted in the acquisition of riparian habitat (and in some cases associated water rights) that could help improve or maintain the status of some aquatic species.

- *Dam and Reservoir Development/Water Developments and Diversions:* These projects have resulted in considerable impacts to aquatic habitat and species both directly and indirectly. Dam and reservoir development began in the late 1800's and continued into the 1960's across the project area. Most of this activity was to provide for downstream (and off Forests) water use and irrigation, and to provide for recreational opportunities. Blue Ridge Reservoir is part of an interbasin transfer to the Verde River to provide water downstream. Most dams and water diversions have detrimental impacts to aquatic species and habitats, and have isolated or separated populations, and dewatered or introduced non-native species into upstream and downstream habitats.

- *Fisheries and Wildlife:* Fisheries habitat improvement work in streams began in the 1930s on the ASNFs. These efforts were in response to degraded habitat conditions (likely from grazing livestock) and were focused on higher elevation trout streams, and intended to stabilize streams and provide pool habitat that had been reduced. Later efforts did not occur until the1970s thru the 1980s, and these efforts were largely focused on areas that had been heavily impacted by past management activities and concentrated recreational use. The Coconino NF began improving streams, springs and watersheds in the 1960s thru the 1990's in response to the degraded conditions. This included instream rock structures and aspen and riparian enclosures. Spring and stream restoration efforts began in the early 2000's as part of watershed planning for West and East Clear Creek as well as Barbershop Canyon.

Current, ongoing, and foreseeable cumulative effects projects within the Rim Country project area are shown in Tables 51-53 below. Some of these projects are in the early stages of proposal development or are on hold, so their implementation is reasonably foreseeable but not assured. The acreages shown under mechanical vegetation management and fuels treatments are not all mutually exclusive. There are many

acres on which proposed fuels treatments (mechanical and prescribed fire) overlap with proposed mechanical vegetation management treatments. Therefore, all acreages or miles are approximate.

Mechanical Vegetation Treatments

The total cumulative acres of mechanical vegetation treatments potentially impacting aquatic indicators for all alternatives are displayed in Table 51 below. The resource measure for all species are expected to result in increased cumulative impacts that are primarily potential impacts to riparian condition. This is also reflective of multiple treatments over time in some subwatersheds that result in treatment acres above the watershed acreage itself.

Alternatives 2 and 3 are expected to have more cumulative effects compared to alternative 1. Alternative 2 would have more cumulative effects from mechanical vegetation treatments than alternative 3. For both alternative 2 and 3, gartersnakes have the potential for the largest increases in cumulative effects.

Table 52. Acres of mechanical vegetation treatments for cumulative effects (Alternative 1) and changes in acres of mechanical vegetation treatments for Alternative 3. Percentages reflect changes in acreages within species analysis areas.

Species	Alternative 1: Total Acres of Mechanical Vegetation Treatment	Alternative 2: Total Acres of Mechanical Vegetation Treatment	Alternative 3: Total Acres of Mechanical Vegetation Treatment/ Percent
Gila trout	25,926	123,399/ 376%	99,918/ 285%
Gila chub*	7,058	19,389/ 175%	9,541/ 35%
Gila topminnow*	2,328	14,311/ 515%	3,662/ 57%
Little Colorado spinedace	64,982	236,372/ 264%	197,769/ 204%
Loach minnow*	2,328	14,311/ 515%	3,662/ 57%
Razorback sucker*	2,328	14,311/ 515%	3,662/ 57%
Spikedace*	2,328	14,311/ 515%	3,662/ 57%
Narrow-headed gartersnake	8,542	81,844/ 858%	46,371/ 443%
Northern Mexican gartersnake	6,290	48,036/ 664%	37,426/ 495%
Desert Sucker	56,287	286,825/ 410%	234,258/ 316%
Sonoran Sucker	17,120	58,527/ 242%	48,865/ 185%
Little Colorado sucker	43,784	184,216/ 321%	149,621/ 242%
Headwater chub	27,131	160,773/ 493%	129,199/ 376%
Roundtail chub	30,663	166,010/ 441%	119,153/ 289%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Mechanical vegetation treatments can negatively impact riparian condition when they occur within riparian areas. Reduction in riparian vegetation cover or structure could occur which are direct impacts to gartersnake critical habitat as well as some aquatic macroinvertebrates species. Indirect impacts of increased stream temperature from loss of canopy cover could occur and associated ground disturbance could increase sediment delivery to streams.

Mechanical vegetation treatments in the upper watershed can indirectly impact riparian condition from increased sediment delivery and peak flows. Soils can be compacted and water infiltration reduced

leading to increased overland flow and erosion. In turn, increased sedimentation and peak flows can occur reducing riparian condition, aquatic habitat quality and quantity.

Potential increases in sediment delivery and peak flows are expected to vary based on current riparian condition. Cumulative impacts for species with impaired riparian condition are expected to be higher as compared to riparian conditions that are functioning properly or functioning at risk. To reduce potential cumulative impacts, design features assessing Equivalent Disturbed area, spacing treatments spatially and temporally are part of both action alternatives.

Long term, alternative 2 has the greatest potential to improve overall riparian condition as well as watershed condition. Alternative 3 would maintain or improve conditions, but at a smaller scale. Alternative 1 not provide for improved riparian condition or watershed condition. Overstocked forests would remain susceptible to uncharacteristic wildfire from canopy closure which would also maintain current states of reduced ground cover from shading. Conifer encroachment would continue into riparian areas reducing streamside vegetation cover and structure normally associated with streams and wetlands.

Prescribed Burning

The total cumulative acres of wildand fire (prescribed and wildfire) potentially impacting aquatic indicators for all alternatives are displayed in Table 52 below. Increased resource measures for all species are expected to result in increased cumulative impacts to riparian condition and individuals. This is also reflective of how frequently some subwatersheds experience wildfire cumulatively adding acreages above the watershed acreage itself.

Alternatives 2 and 3 are expected to have more cumulative effects compared to alternative 1. Alternative 2 would have more cumulative effects from prescribed burning than alternative 3. For alternative 2, Northern Mexican gartersnake and Headwater chub have the potential for the largest increases in cumulative effects, while Roundtail chub and Gila trout have the largest increases under alternative 3.

Table 53. Acres of burning and wildfire for cumulative effects (Alternative 1) and changes in acres of prescribed burning for Alternative 3. Percentages reflect changes in acreages within species analysis areas.

Species	Alternative 1: Acres of Burning	Alternative 2: Acres of Prescribed Burning/ Percent Increase	Alternative 3: Acres of Prescribed Burning/ Percent Increase
Gila trout	60,777	158,250/ 160%	142,481/ 134%
Gila chub*	7,992	20,323/ 154%	10,485/ 31%
Gila topminnow*	8,043	12,726/ 58%	9,377/ 17%
Little Colorado spinedace	158,178	329,568/ 108%	308,616/ 95%
Loach minnow*	8,043	12,726/ 58%	9,377/ 17%
Razorback sucker*	8,043	12,726/ 58%	9,377/ 17%
Spikedace*	8,043	12,726/ 58%	9,377/ 17%
Narrow-headed gartersnake	99,508	172,810/ 74%	142,964/ 44%
Northern Mexican gartersnake	26,036	99,338/ 282%	60,774/ 133%
Desert Sucker	155,830	386,368/ 148%	355,831/ 128%
Sonoran Sucker	44,650	86,057/ 93%	80,117/ 79%
Little Colorado sucker	97,073	237,505/ 145%	219,583/ 126%
Headwater chub	50,610	184,252/ 264%	162,445/ 221%
Roundtail chub	71,229	206,576/ 190%	171,036/ 140%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Wildfire can negatively impact riparian condition within species habitats. Riparian vegetation cover or structure can be reduced as well as large wood recruitment. Decreases in willows and other shrubby species reduces hiding and thermal cover for gartersnakes, which is an alteration of gartersnake critical habitat as well as some aquatic macroinvertebrate habitats. Prescribed fire would only cause these reductions until vegetation recovers, while wildfires can have a much greater impact due to moderate and high burn severity. Reduction in canopy cover also reduces stream shading and organic matter inputs to streams which can alter food webs and prey base for fish and gartersnakes. Indirect impacts of increased stream temperature from loss of canopy cover could also occur, but should be limited based on design features associated with limiting high burn severity (mortality) within riparian areas.

Wildfires in the upper watershed can also cumulatively effect riparian to a greater extent due to increased sedimentation and peak flows. Prescribed fires generally limit moderate and high severity within watersheds; while wildfire does not. Therefore cumulative effects would vary depending on what type of fire occurred. In turn, increased sedimentation and peak flows can occur reducing riparian condition, aquatic habitat quality and quantity.

Potential increases in sediment delivery and peak flows are expected to vary based on current riparian condition. Cumulative impacts for species with impaired riparian condition are expected to be higher as compared to riparian conditions that are functioning properly or functioning at risk. To reduce potential cumulative impacts, design features assessing Equivalent Disturbed area, spacing treatments spatially and temporally are part of both action alternatives.

Impacts to individual gartersnakes in the form of mortality or modification of behavior could also occur from wildfire. Mortality is less likely to occur during prescribed burning than from wildfire. Wildfires tend to occur during the driest time of year, can move rapidly and have increased fire behavior. Riparian areas generally have high fuel loading and continuity from being buffered from any treatments for decades and can therefore carry wildfire leading to potential mortality.

Long term effects of prescribed burning are expected to be positive for riparian condition for alternative 2 and 3. Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future. Large woody debris recruitment and streamside cover or structure can also improve with prescribed fire. Alternative 1 could potentially lead to reduced riparian condition from the susceptibility to wildfire, particularly uncharacteristic wildfire.

Stream, Riparian, and Wet Meadow Restoration

The total cumulative miles of aquatic restoration potentially impacting aquatic indicators could not be identified spatially. Therefore, Table 53 below reflects the restoration between the three alternatives. Aquatic restoration activities have been individual small efforts described above. In general, these activities have a small footprint and any negative effects are short-lived by their very nature.

Table 54. A comparison of the total miles of general and heavy mechanical stream treatments for all three alternatives.

Species	Alternative 1	Alternative 2&3 General Stream Treatments	Alternative 2&3 Heavy Mechanical Stream Treatments
Gila trout	0	7	4
Gila Chub	0	0	0
Gila topminnow	0	0	0

Species	Alternative 1	Alternative 2&3 General Stream Treatments	Alternative 2&3 Heavy Mechanical Stream Treatments
Little Colorado spinedace	0	179	24
Loach minnow	0	0	0
Razorback sucker	0	0	0
Spikedace	0	0	0
Narrow-headed gartersnake	0	0	0
Northern Mexican gartersnake	0	0	0
Desert Sucker	0	51	0
Sonoran Sucker	0	5	0
Little Colorado sucker	0	123	0
Headwater chub	0	9	18
Roundtail chub	0	23	3

Additional Species not Covered by Resource Indicators and Measures

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles are strongly associated with streams and riparian areas. Based on the biology and ecology of these four groups of species, streams and riparian areas could have negative cumulative impacts from Alternative 3, but less than Alternative 2 given the reduced mechanical vegetation treatments, prescribed burning, and temporary roads. Mechanical vegetation treatments, prescribed burning, and roads can negatively impact riparian condition, aquatic habitat quality and quantity utilized by these sensitive species. However, alternative 1 has the greatest potential long term risk to habitat for aquatic macroinvertebrates. By not making forests more resilient, the landscape remains susceptible to wildfires which have an even greater overall impact. Alternative 1 would also not reduce road density by decommissioning roads or reduce impacts to riparian condition by relocating roads. Alternatives 2 and 3 have the potential to improve riparian conditions by restoring form and function of streams, wet meadows and springs which are the primary habitat of these sensitive species.

Required Monitoring

Monitoring would be conducted as appropriate for a specific action, both during and after a project, to track effects and compliance with this analysis:

A qualified, permitted biologist will be on site during heavy equipment construction activities to attempt to protect narrow-headed or northern Mexican garter snakes and/or key habitat features during construction. This will occur within proposed critical habitat for construction zones in the following project types in the Aquatic and Watershed Flexible Toolbox Approach (AWFTA):

- Fish Passage Restoration
- Large Wood, Boulder, and Gravel Placement
- Legacy structure removal or maintenance
- Channel Reconstruction/Relocation

• Off- and Side-Channel Habitat Restoration
• Streambank Restoration
• Set-back or Removal of existing berms for aquatic restoration
• Beaver Habitat Restoration

Forest Plan Amendment Environmental Consequences – By Alternative or in a summary

There are three project level amendments proposed as part of Rim Country for the Tonto NF Land and Resource Management Plan. These amendments are for Mexican spotted owl, northern goshawk and slope restrictions.

The Mexican spotted owl (MSO) amendment would update the Tonto Forest Plan so it is consistent with the 2012 MSO recovery plan; which the Apache-Sitgreaves and Coconino Forest Plans already incorporate. This plan amendment updated definitions, language, and treatments within MSO habitat. It does not impact the analysis for aquatic species or habitats in regards to any alternative.

The goshawk amendment would update guidance and direction in the Tonto Forest Plan so it is consistent with the Apache-Sitgreaves and Coconino NFs revised forest plan management direction. This amendment does not impact the analysis for aquatic species or habitats in regards to any alternative.

The slope restrictions amendment would remove language from the Tonto Forest Plan restricting mechanical equipment to slopes less than 40 percent as well as removing language that identifies those slopes as inoperable. Rim Country proposed the use of specialized mechanical equipment to restore steep slopes. The acreages of mechanical vegetation treatments analyzed in regards to aquatic species and habitats includes steep slopes for both action alternatives across all three Forests.

Summary

Degree to Which the Purpose and Need for Action is Met

The purpose and need in relation aquatic resources includes restoring riparian and aquatic habitats (riparian condition). Mechanical vegetation treatments and prescribed burning address that need by improving watershed condition and reducing the risk of uncharacteristic wildfire. General and heavy mechanical stream treatments specifically address that need by directly improving these habitats which should lead to improved aquatic habitat and populations. Alternatives 2 and 3 have the potential to improve riparian and stream conditions for seven aquatic species (Table 53). The other seven species would not benefit from this for multiple reasons. Five fish species do not occur within the project area, therefore no proposed treatments would occur within their habitat. The two gartersnakes only occur in locations within the project area where proposed treatments may not be successful (high gradient streams) or are difficult to access. Alternative 1 would not restore any aquatic habitat, therefore current riparian condition would remain the same or be reduced by encroachment or wildfire.

Degree to Which the Alternatives Address the Issues

Aquatic species and/or habitats was not an Issue identified during scoping.

Summary of Environmental Effects

This is a concise summary comparison of the effects of the alternatives, describing your conclusions and including the "so what?" narratives to clearly explain what your analysis means for your resource. It includes the resource indicators and measures you used in your analysis to measure and disclose effects. It is objective and does not draw conclusions of which alternative is best.

Mechanical Vegetation Treatments

The total acres of mechanical thinning impacting aquatic species for the three alternatives are displayed in Table 54 below. For all aquatic species, the total acres of mechanical thinning will increase for the action alternatives (i.e., alternatives 2 and 3), and will result in an increase to the current levels of direct, indirect, and cumulative impacts. They could cause potential short and mid-term impacts to riparian condition, modification of behavior, harm, and introduction of pollutants or exotic/invasive species. These can negatively impact aquatic species and habitat over time by altering habitat and reducing food base (e.g., periphyton, macroinvertebrates, and fish). Species can be displaced to areas that are more suitable to their specific needs. Because implementation of individual mechanical thinning treatments occur over a longer period time, these impacts could occur at some level within species action areas throughout the life of the project. Long-term, Alternatives 2 and 3 will restore forest structure and resiliency which is expected to reduce the risk of uncharacteristic fire and associated subsequent negative effects. Alternative 1 would not have increase direct, indirect, or cumulative impacts, but would have long-term impacts by perpetuating unusually high stand densities and the probability for catastrophic fire increases. Uncharacteristic wildfire has the potential to greatly reduce riparian condition and aquatic resources. Alternative 1 would not improve riparian or watershed condition, whereas alternatives 2 and 3 would to a lesser or greater degree.

Table 55. A comparison of the total acres of mechanical vegetation treatments (direct & indirect) for all three Alternatives.

Species	Alternative 1	Alternative 2	Alternative 3
Gila trout	0	91,374	75,375
Gila Chub	0	13,910	2,493
Gila topminnow	0	10,028	1,334
Little Colorado spinedace	0	157,710	140,571
Loach minnow	0	10,028	1,334
Razorback sucker	0	10,028	1,334
Spikedace	0	10,028	1,334
Narrow-headed gartersnake	0	68,119	39,871
Northern Mexican gartersnake	0	39,434	32,360
Desert Sucker	0	212,584	181,840
Sonoran Sucker	0	37,817	32,449
Little Colorado sucker	0	127,023	111,748
Headwater chub	0	124,947	103,933
Roundtail chub	0	126,522	90,366

Prescribed Burning

The total acres of prescribed burning impacting aquatic species for the three alternatives are displayed in Table 55 below. For all aquatic species, the total acres of prescribed burning will increase for the action alternatives (i.e., alternatives 2 and 3), and will result in an increase to the current levels of direct, indirect, and cumulative impacts. Potential impacts include the direct and indirect loss of riparian canopy

and structure, increased erosion and sedimentation, increased peak flows, and introduction of pollutants. These can negatively impact aquatic species and habitat over time by altering habitat and reducing food base (e.g., periphyton, macroinvertebrates, and fish). Species can be displaced to areas that are more suitable to their specific needs. Prescribed burning impacts could occur at some level within species action areas throughout the life of the project. However, individual burn blocks are generally completed as a unit. Therefore, direct impacts are short-lived and indirect impacts can occur until ground vegetation is reestablished to filter potential sediment. Long-term, Alternatives 2 and 3 would reduce fuel loading and restore a more natural fire regime which can improve riparian condition. It would also reduce the risk of uncharacteristic fire and associated subsequent negative effects. Alternative 1 would not have increased direct, indirect, or cumulative impacts, but would have long-term impacts by perpetuating unusually high fuel loading and the probability for catastrophic fire increases. Alternative 1 would not improve riparian or watershed condition, whereas alternatives 2 and 3 would to a lesser or greater degree.

Table 56. A comparison of the total acres of prescribed burning for all three Alternatives.

Species	Alternative 1	Alternative 2	Alternative 3
Gila trout	0	99,085	83,235
Gila Chub	0	12,331	2,493
Gila topminnow	0	11,983	1,334
Little Colorado spinedace	0	183,728	159,924
Loach minnow	0	11,983	1,334
Razorback sucker	0	11,983	1,334
Spikedace	0	11,983	1,334
Narrow-headed gartersnake	0	75,740	45,668
Northern Mexican gartersnake	0	43,009	36,735
Desert Sucker	0	241,681	204,527
Sonoran Sucker	0	42,185	32,241
Little Colorado sucker	0	150,023	131,524
Headwater chub	0	135,802	113,852
Roundtail chub	0	138,234	102,138

ML-1 Roads

The total number of open road miles impacting aquatic species and habitats for the three alternatives are displayed in Table 56 below. For all aquatic species the total open road miles will increase for the action alternatives (i.e., Alternatives 2 and 3). This would result in an increase to the current levels of direct, indirect, and cumulative impacts. Short to mid-term impacts include reduced riparian condition, modification of behavior or harm of species, and introduction of pollutants or exotic/invasive species. Long term impacts would be neutral. Because implementation of individual treatments occur over a longer period time, these impacts could occur at some level within species action areas throughout the life of the project. Once harvest units are completed and closed out, ML-1 roads will be closed and road density decreased.

Table 57. A comparison of the total miles of open roads for all three Alternatives.

Species	Alternative 1	Alternative 2	Alternative 3
Gila trout	239	333	333
Gila Chub	61	63	63
Gila topminnow	63	72	72
Little Colorado spinedace	935	1,809	1,809
Loach minnow	63	70	70
Razorback sucker	63	70	70
Spikedace	63	70	70
Narrow-headed gartersnake	177	381	381
Northern Mexican gartersnake	90	147	147
Desert Sucker	1,057	1,484	1,484
Sonoran Sucker	112	247	247
Little Colorado sucker	796	1,452	1,452
Headwater chub	354	451	451
Roundtail chub	475	919	919

In Woods Processing (IWPS) and Biomass Storage

Table 57 contains the current acres of in woods processing sites in Alternative 1, and the total amount of acres that will be open for IWPS in Alternatives 2 and 3. For seven aquatic species, the acres of IWPS will increase for the action alternatives (i.e., Alternatives 2 & 3) which could result in a reduction in riparian condition. The other seven aquatic species would not be impacted at all by IWPS. Impacts to riparian condition would include increased erosion and sedimentation. While sedimentation is possible, IWPS locations were selected to minimize any potential impacts (e.g. 200ft from stream channels) to aquatic species or habitats.

Table 58. A comparison of the total acres of in woods processing for all three Alternatives.

Species	Alternative 1	Alternative 2	Alternative 3
Gila trout	0	0	0
Gila Chub	0	0	0
Gila topminnow	0	0	0
Little Colorado spinedace	0	26	26
Loach minnow	0	0	0
Razorback sucker	0	0	0
Spikedace	0	0	0
Narrow-headed gartersnake	0	3	3
Northern Mexican gartersnake	0	3	3
Desert Sucker	0	57	57
Sonoran Sucker	0	0	0
Little Colorado sucker	0	25	25
Headwater chub	0	9	9
Roundtail chub	0	39	39

Rock Pit Use and Expansion

Table 58 contains the acres of rock pit use and expansion for each alternative. Six species would have an increased acreage of rock pits for the action alternatives (i.e., Alternatives 2 & 3) which could result in negative indirect and cumulative impacts to riparian condition, but not direct impacts. Given the location and distance of the proposed rock pits to any riparian area or stream, potential effects are considered unlikely. Little Colorado spinedace and Little Colorado sucker would have the greatest increase in potential impacts. Eight aquatic species will not be impacted by rock pits.

Table 59. A comparison of the total acres of rock pits for all three Alternatives.

Species	Alternative 1	Alternative 2	Alternative 3
Gila trout	0	0	0
Gila Chub	0	0	0
Gila topminnow	0	0	0
Little Colorado spinedace	20	200	200
Loach minnow	0	0	0
Razorback sucker	0	0	0
Spikedace	0	0	0
Narrow-headed gartersnake	0	5	5
Northern Mexican gartersnake	0	5	5
Desert Sucker	0	5	5
Sonoran Sucker	0	0	0
Little Colorado sucker	0	103	103
Headwater chub	0	5	5
Roundtail chub	0	0	0

Stream, Riparian, Wet Meadow, and Spring Restoration

Table 59 contains the miles general and heavy mechanical stream restoration treatments across all three alternatives. Stream restoration treatments associated with alternatives 2 and 3 would increase direct, indirect, and cumulative impacts to riparian condition for seven aquatic species; while the remaining seven species would not be impacted. Riparian condition could have negative short-term impacts; however, mid- and long-term positive impacts would improve riparian and watershed condition. Alternative 1 would not improve riparian condition, but would maintain it at current conditions of functioning at risk or impaired for many of the species.

Table 60. A comparison of the total miles of general and heavy mechanical stream treatments for all three Alternatives.

Species	Alternative 1	Alternative 2&3 General Stream Treatments	Alternative 2&3 Heavy Mechanical Stream Treatments
Gila trout	0	7	4
Gila Chub	0	0	0
Gila topminnow	0	0	0
Little Colorado spinedace	0	179	24
Loach minnow	0	0	0
Razorback sucker	0	0	0

Species	Alternative 1	Alternative 2&3 General Stream Treatments	Alternative 2&3 Heavy Mechanical Stream Treatments
Spikedace	0	0	0
Narrow-headed gartersnake	0	0	0
Northern Mexican gartersnake	0	0	0
Desert Sucker	0	51	18
Sonoran Sucker	0	5	3
Little Colorado sucker	0	123	14
Headwater chub	0	9	7
Roundtail chub	0	23	3

Table 61. Summary comparison of environmental effects to aquatic resources.

Resource Element	Indicator	Alternative 1	Alternative 2	Alternative 3
Acres of Mechanical Vegetation Treatments				
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition -Short and Mid-term effects negative - Long Term effect neutral or positive 2. Modification of Gartersnake Behavior - Short and Mid-term effects negative - Long Term effect neutral or positive 3. Direct Mortality of Gartersnakes - Short term effects negative - Mid and Long Term Effects Neutral 4. Pollutants, Invasive Species - Short, Mid-, and Long Term effects negative	No potential for short to mid-term negative effects to riparian condition, modification of behavior, harm to individuals, and introduction of pollutants or invasive species. By not restoring vegetation toward desired conditions, riparian and watershed condition with remain the same or degrade and the risk of uncharacteristic wildfire to aquatic resources remains.	Short to mid-term negative impacts from 889,344 acres of mechanical vegetation treatments on riparian condition, modification of behavior, harm to individuals and introduction of pollutants or invasive species. Design features would minimize or mitigate most negative impacts to resource indicators. Vegetation treatments will promote or improve riparian and watershed condition long term. The risk for uncharacteristic wildfire is reduced across all treated acres.	Same as alternative 2, but less potential effects from only 486,157 acres of mechanical vegetation treatments
Acres of Prescribed Burning				

Resource Element	Indicator	Alternative 1	Alternative 2	Alternative 3
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral or positive 2. Modification of Gartersnake Behavior - Short and Mid-Term effects negative - Long Term effect neutral or positive 3. Harm of Gartersnakes - Short term effects negative - Mid and Long Term Effects Neutral 4. Pollutants, Invasive Species - Short, Mid-, and Long Term effects negative	No potential for short to mid-term negative effects to riparian condition, modification of behavior, harm to individuals, and introduction of pollutants or invasive species. By not restoring vegetation to desired conditions and restoring the fire regime, riparian and watershed condition will remain the same or degrade and the risk of uncharacteristic wildfire to aquatic resources remains.	Short to mid-term negative impacts from 953,132 acres of prescribed fire to riparian condition, modification of behavior, harm to individuals and introduction of pollutants or invasive species. Design features would minimize or mitigate most negative impacts to resource indicators. Vegetation treatments will promote or improve riparian condition long term.	Same as Alternative 2, but less potential effects from only 529,059 acres of prescribed fire.
Miles of Open ML-1 Roads and Temporary Roads				
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-Term effects negative - Long Term effect neutral or positive 2. Habitat Connectivity - Short and Mid-Term effects negative - Long Term effect neutral 4. Pollutants, Invasive Species - Short, Mid-, and Long Term effects negative	No potential for short to mid-term negative effects to riparian condition, modification of behavior, harm to individuals, and introduction of pollutants or invasive species.	Short to mid-term negative impacts from opening 2,076 miles of ML-1 roads and 330 miles of temporary roads to riparian condition, habitat connectivity, and introduction of pollutants or invasive species. Design features would minimize or mitigate most negative impacts to resource indicators.	Same as Alternative 2, but slightly less potential effects to indicators with only 170 miles of temporary roads.
Acres of In Woods Processing Sites				

Resource Element	Indicator	Alternative 1	Alternative 2	Alternative 3
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral	No potential for short to mid-term negative effects to riparian condition.	Short to mid-term negative impacts in riparian condition. Design features would minimize or mitigate most negative impacts to resource indicators.	Same as Alternative 2.
Acres of Rock Pits				
Habitat Quality Habitat Quantity	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect neutral	No potential for short to mid-term negative effects to riparian condition.	Short to mid-term negative impacts in riparian condition. Design features would mitigate or eliminate most negative impacts to resource indicators.	Same as Alternative 2.
Miles of General and Heavy Mechanical Stream Restoration				
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short term effects negative - Mid- and long Term effect positive 2. Instream Aquatic Habitat - Short effects negative - Mid and Long Term effects positive 3. Harm of Fish or Gartersnakes - Short effects negative - Mid and Long Term effect neutral or positive 4. Pollutants, Invasive Species - Short, Mid-, and Long Term effects negative	No potential for short to term negative effects to riparian condition, instream aquatic habitat, harm to individuals, and introduction of pollutants or invasive species. Riparian condition and instream aquatic habitat would be maintained at current levels or potentially degrade further over time.	Short term impacts to riparian condition, instream aquatic habitat, harm to individuals and pollutants or invasive species. Design features would minimize or mitigate most negative impacts to resource indicators. Long term beneficial impacts of improved riparian condition and instream aquatic habitat.	Same as Alternative 2.
Road Decommissioning and Relocation				

Resource Element	Indicator	Alternative 1	Alternative 2	Alternative 3
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short and Mid-term effects negative - Long Term effect positive 3. Harm of Fish or Gartersnakes - Short effects negative - Mid and Long Term effect neutral	No potential for short to term negative effects to riparian condition or harm to individuals. There would be no decrease in road density or improvement of riparian condition from decommissioning or relocating roads.	Short term impacts to riparian condition from sediment input and harm to individuals from decommissioning up to 200 miles of roads and relocating any roads affecting aquatic resources. Design features would minimize or mitigate most negative impacts to resource indicators. Long term beneficial impacts of improved riparian condition and watershed condition from reducing road density, sedimentation, and peak flows.	Same as Alternative 2.

Compliance with LMP and Other Relevant Laws, Regulations, Policies and Plans

Compliance with the plan components of LMPs (Coconino and Apache-Sitgreaves NFs) and LRMP (Tonto NF) is addressed below under Forest Plan Consistency as well as Appendix D. This Specialist Report along with the associated Biological Evaluation, Biological Assessment and Section 7 consultation under the Endangered Species Act (as amended) fulfill compliance with other laws, regulations, and policies for planning purposes.

Other Relevant Mandatory Disclosures

Required Permits

Any biologists conducting species surveys or monitoring are required to have a federal recovery permit and a state collecting license.

Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources will occur in regards to the use and expansion of rock pits. Mineral extraction from rock pits is irreversible as it inherently consumes nonrenewable resources, or a resource than can only be renewed over a long period of time. For aquatic species and habitats, this will not relate to any direct effects. Indirect effects as discussed above could potentially lead to an increase in sedimentation within species action areas that could alter habitats.

Forest Plan Consistency

NFMA requires that projects and activities be consistent with the governing Forest Plan (16 USC 1604 (i)).

Desired Conditions – to be consistent with the DCs of the plan, a project or activity, when assessed at the appropriate spatial scale described in the plan (e.g., landscape scale), must be designed to meet one or more of the following conditions:

- Maintain or make progress toward one or more of the DCs of a plan without adversely affecting progress toward, or maintenance of, other DCs; or
- Be neutral with regard to progress toward plan DCs; or
- Maintain or make progress toward one or more of the DCs over the long term, even if the project or activity would adversely affect progress toward or maintenance of one or more DCs in the short term; or
- Maintain or make progress toward one or more of the DCs over the long term, even if the project or activity would adversely affect progress toward other DCs in a negligible way over the long term.

The action alternatives (Alternative 2 & 3) are consistent with the Forest Plan Desired Conditions as it will either make progress towards DCs or be neutral in regard to some DCs. The adaptive management outlined addresses resource issues and concerns brought forward by the IDT and incorporated measures to meet those needs where feasible. The proposed activities are designed to either be neutral toward DCs or minimize short-term negative impacts to DCs and progress toward DCs long-term. Forest Plan consistency is documented for all plan components relative to aquatic species and habitat in Appendix D.

Standards are constraints upon a project/activity. A project/activity must be consistent with all standards applicable to the type of project or activity and its location in the plan area. A project is consistent with a standard in only one way: It is designed in exact accord with the standard.

Guidelines – a project or activity is consistent with a guideline in either of two ways:

1. The project or activity is designed exactly in accord with the guideline; or

2. A project or activity design varies from the exact words of the guideline, but it is as effective in meeting the purpose of the guideline to contribute to the maintenance or attainment of the relevant desired conditions or objectives.

Other Agencies and Individuals Consulted

Arizona Game and Fish Department: provided geospatial species occurrences and survey reports, review of species occurrence geospatial data created for project, workshops to test the Aquatic and Watershed Flexible Toolbox.

Yvette Paroz, Regional Fisheries Program Manager, USDA Forest Service, Region 3: assistance with development of Aquatic and Watershed Flexible Toolbox, review of species occurrence geospatial data created for project; and review of specialist report.

Ernie Taylor, Budget Coordinator, USDA Forest Service, Region 3: assistance with development of circumstances table in the Aquatic and Watershed Flexible Toolbox, and review of specialist report.

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Appendix A: Watershed Condition Framework aquatic habitat indicators by subwatershed.

Subwatershed	Aquatic Physical Habitat	Aquatic Biota	Aquatic Riparian/ Wetland Vegetation	Water Quality	Roads & Trails
Alder Canyon	Fair	Good	Fair	Good	Poor
Barbershop Canyon	Fair	Poor	Poor	Good	Good
Bear Canyon	Fair	Poor	Poor	Good	Fair
Bear Canyon-Black Canyon	Good	Fair	Poor	Good	Poor
Buckskin Canyon-Carrizo Creek	Poor	Fair	Fair	Fair	Fair
Bull Tank Canyon-Tonto Creek	Poor	Fair	Poor	Poor	Fair
Buzzard Roost Canyon	Fair	Fair	Fair	Good	Poor
Canyon Creek Headwaters	Fair	Poor	Fair	Good	Fair
Christopher Creek	Poor	Poor	Poor	Poor	Poor
Durfee Draw-Chevelon Canyon	Good	Poor	Good	Good	Fair
East Clear Creek-Blue Ridge Reservoir	Fair	Poor	Poor	Good	Fair
East Clear Creek-Clear Creek	Fair	Poor	Fair	Good	Poor
East Verde River Headwaters	Poor	Fair	Poor	Good	Poor
Echinique Draw-Clear Creek	Good	Poor	Good	Good	Good
Ellison Creek	Fair	Poor	Fair	Good	Poor
Ellison Creek-East Verde River	Good	Fair	Fair	Good	Poor
Gentry Canyon-Upper Clear Creek	Poor	Good	Fair	Good	Poor
Gordon Canyon	Poor	Fair	Poor	Good	Poor
Gruwell Canyon-Cherry Creek	Poor	Fair	Poor	Good	Poor
Haigler Creek	Fair	Fair	Fair	Good	Poor
Horton Creek-Tonto Creek	Fair	Poor	Fair	Fair	Poor
Leonard Canyon	Poor	Poor	Poor	Good	Fair
Long Tom Canyon-Chevelon Canyon	Good	Poor	Good	Good	Poor
Lower Willow Creek	Fair	Poor	Fair	Good	Fair
Miller Canyon	Good	Fair	Poor	Fair	Fair
Pine Creek	Poor	Fair	Poor	Good	Good
Red Tank Draw	Poor	Poor	Fair	Poor	Good
Rock Creek-Spring Creek	Fair	Fair	Fair	Fair	Poor
Upper Chevelon Canyon-Chevelon Canyon Lake	Poor	Poor	Good	Good	Fair
Upper Fossil Creek	Good	Fair	Good	Fair	Fair
Upper Salome Creek	Fair	Fair	Fair	Good	Poor
Upper Spring Creek	Fair	Fair	Fair	Good	Poor
Upper Willow Creek	Poor	Poor	Fair	Poor	Poor
Webber Creek	Fair	Fair	Fair	Fair	Poor
Wilkins Canyon	Fair	Good	Poor	Good	Fair
Woods Canyon and Willow Springs Canyon	Fair	Poor	Fair	Good	Fair
Workman Creek	Good	Poor	Good	Good	Poor

Appendix B: Rim Country Flexible Toolbox Approach for Aquatic and Watershed Restoration Activities

The Rim Country project area encompasses over 1.2 million acres ranging in elevation from around 4,300 to 8,850 feet and includes 11 target vegetation cover types. This project area includes stream types ranging from high gradient headwater streams, meandering meadow reaches, and low gradient depositional valleys. There are approximately 4,000 miles of stream channels, including perennial, intermittent, and ephemeral. Wetlands such as wet meadows and springs also occur, providing unique aquatic and riparian habitats. There are 411 known springs on the three national forests that are either developed or undeveloped, and occur in meadow or riparian settings. It is estimated there are up to 10 times the number of unmapped springs that are not developed in the Rim Country project area. Riparian areas include vegetation types such as herbaceous sedge/rush, willow/alder, and cottonwood/sycamore vegetation.

Conditions within these watershed and aquatic systems range from relatively pristine to highly impacted. There are legacy impacts from timber management, channel modification, water developments such as springs and stock tanks, unregulated grazing, as well as more contemporary impacts from roads, non-native species, wildfires, recreation, and off-highway vehicle use. Some of these impacts are irreversible; however, in many systems there is potential for a new functional equilibrium. In other systems, there is the opportunity for either full restoration or preventing further degradation.

In general, desired conditions are functional soil, vegetation, and water resources, consistent with their flood regime and flood potential, which provide for diverse habitats. Stream channels have functioning floodplains and dissipate flood energy, as well as support connected riparian areas.

The toolbox addresses the effects of roads on watershed and aquatic systems, such as unauthorized routes and trails and stream crossings. The miles of unauthorized routes (roads or trails) within the project area are unknown, but their effects on these systems can easily be generalized. Based on current mapping, it is estimated that there are over 800 road and stream crossings in the project area. It is assumed that road crossings are generally stable on maintenance level 3 thru 5 roads (suitable for passenger cars to high degree of user comfort), and range from stable to unstable on maintenance level 1 and 2 roads (basic custodial care, i.e., closed, to open to high clearance vehicles). Existing maintenance level 1 and 2 roads which are potentially causing resource damage are addressed in the toolbox as well as maintenance level 3-5 roads which may be destabilizing streams.

Due to the size and complexity of the 1.24-million-acre Rim Country project area, and the variety and scope of the proposed activities, site-specific identification and analysis of all areas of need, or the possible combinations of restoration activities needed for each is not feasible within the necessary timeframe for Rim Country analysis. Complete baseline information on the condition of every acre is not currently available. However, there are a few categories of watershed and aquatic impairments that are common throughout the project area that may be appropriately addressed with a suite of restoration treatments, referred to as ”tools”, with predictable effects that can be analyzed in this project.

There is a wealth of information available to help make informed decisions on what kinds of restoration tools would be appropriate for certain site conditions. Altered or degraded riparian and aquatic habitat conditions generally occur across similar landscape features. To ensure the proper tools are available to help design specific watershed and aquatic restoration treatments for a variety of existing conditions, we propose to use a flexible toolbox approach so that local prescriptive treatments can be customized to current site-specific conditions. Landscape features that affect watershed and aquatic systems and how they function include: valley width, gradient, upland and riparian cover types, slope, access, soil types,

hydrology (stream or spring flow), and substrate size. These features would be considered in determining site specific restoration treatments and the appropriate tools.

Having a suite of tools available for restoration helps account for imperfect information and adjust treatments in a variety of existing conditions, enabling project implementers to find the best solutions for a site-specific problem. Tools that might be appropriate in one area (e.g., stream type) may not be the right tool somewhere else. This flexible toolbox approach provides the ability to adapt treatments to unanticipated conditions or adapt treatments if monitoring indicates the effects of the project will differ from what was predicted in the analysis. Treatments that may cause effects potentially beyond the sideboards or limitations described in the original NEPA analysis would require subsequent NEPA analysis. Whenever possible, restoration treatments should be coordinated with other activities in the same area to create efficiencies. Restoration treatments could be incorporated into mechanical thinning contracts or stewardship agreements, or could be stand-alone projects specifically developed to address high-priority needs for comprehensive restoration.

This flexible toolbox approach applies to all action alternatives. Before carrying out aquatics and watershed restoration treatments, project leaders, specialists, and partners would look at a specific area to be treated and select the appropriate restoration tool(s). Some of the factors to be considered when designing these projects are: the extent and cause of the degraded resources, water quality issues, threatened and endangered species habitat, scenic sensitivity levels, and effects on non-forest lands. Design criteria, best management practices, and mitigation and conservation measures developed for the Rim Country Project would be applied to the flexible toolbox.

Implementation Decision Matrix

To guide implementation of aquatics and watershed restoration treatments and assist with their prioritization, a decision matrix was developed to be included in the flexible toolbox approach. The matrix gives guidance on the types of information to collect to identify the need for restoration treatments, identify potential restoration options and constraints, and prioritize projects for implementation.

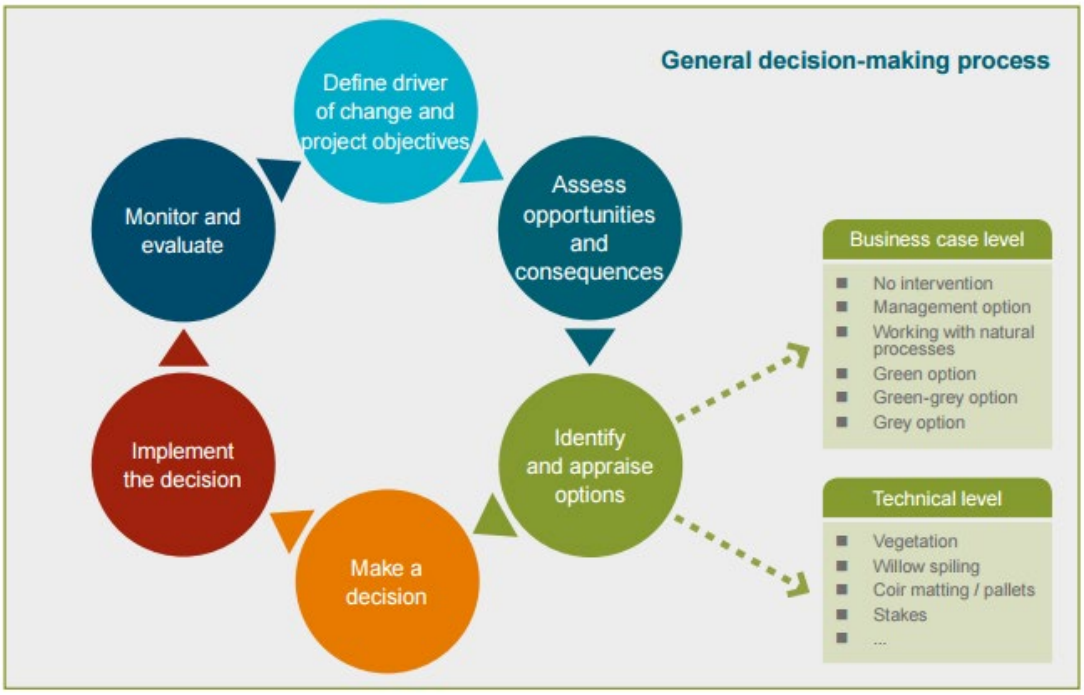

Figure 1. General decision-making process (Roca, et al. 2017)

Define driver of change and project objectives: The first step is identifying potential sites where restoration activities may be needed. Once sites are determined, information is needed to determine the existing baseline conditions and to understand any underlying causes of degradation. A baseline will need to be identified for the activity site using existing conditions and potentially reference sites if the activity site is degraded. The baseline for the site is what all restoration options should be assessed against to provide a basis for comparison. Understanding the drivers of change or causes of degradation is necessary to define the best approach and reach the most appropriate solution. The baseline should account for existing condition and drivers of change. In turn, objectives for the restoration activities in relation to improving the baseline condition should be determined.

Key Information that may be needed:

- Site reconnaissance: IDT, partners, stakeholders walk the potential project area to identify areas of concern and potential causes.
    - Landforms (valley type (transport vs. depositional reaches), relic channels, floodplains, very old trees, distinct reach breaks.
    - Occurrence of excess erosion or deposition, loss or change in species composition or density (plant or animal).
    - Signs of manipulation (berms, ditches, skid roads, landings, unusually flat surfaces, hummocks, old or unauthorized roads, infrastructure, etc….)
- Research the history of an area.
    - Historic aerial photos
    - USFS photo archives, local historical societies, universities
    - Prior reports and local knowledge
    - Try to piece together what happened to cause the degradation.
- Characterize the past, current, and likely future trajectory of the area (e.g. SEM or Rosgen stream type, spring type, riparian successional stage, or Proper Functioning Condition.
- Assessment and inventory:
    - Valley and channel types (valley and channel gradients, entrenchment ratio, width to depth ration, sinuosity)
    - Hydrology (flood, low flow, bankfull, regional curves, channel bed material, roughness).
    - Sediment inputs (roads, fires, other land ownership, banks)
    - Riparian habitat and condition (existing, potential, and function)
    - Habitat connectivity (aquatic, terrestrial)
    - Forest resources (terrestrial and aquatic species, rare plants, weeds, etc…)
    - Springs Ecosystem Assessment Protocol (SEAP) evaluation (Springs Stewardship Institute).
- Determine potential cause(s) of the problem (I.e. human activity, animals, past management, or natural processes). Whenever feasible, manage the cause of the problem rather than its symptoms.
- Determine the baseline of the system to adequately assess all restoration treatments.
- Identify any drivers likely to impact the system over its lifetime (e.g. growth, climate change).

Assess opportunities, consequences, and constraints: Identifying potential consequences of current condition (e.g. bank or bed erosion) and the opportunities to improve site conditions should be assessed to

inform the identification of measures and their prioritization. Constraints of a potential project also need to be identified such as accessibility, nearby land ownership, and roads that cannot be moved are beneficial to determining restoration opportunities, prioritization, and potential treatments to be used. Potential short and long-term consequences of potential treatments should also be identified. Finally, the scope of the potential activity needs to be evaluated to determine if the fit within the constraints of the NEPA.

- Promote resilient ecological functions of the system being assessed.
- Integrate approaches to seek solutions that deliver multiple benefits whilst increasing resilience.
- All feasible options should be clearly set out and described in relation to the baseline.
- Describe and assess key impacts to all stakeholders, both positive and negative for each restoration treatment.
- Determine restoration projects scope
    - Start big and whittle down based on process drivers.
    - Find a downstream vertical grade control (start of a canyon reach, natural nick point, etc.)
- For springs (Springs Stewardship Institute): Evaluate condition and need for spring function and species use. Develop specific goals for restoration
    - Restore the site to as nearly natural and ecologically functioning a condition as possible OR restore specific resources, characteristics or populations as desired by the manager OR restore other desired future condition of the site
    - Consider: Minimizing maintenance costs and activities
- For developed springs
    - Evaluate the water use needs and costs, irrigation schedule, and maintenance
    - Identify features to preserve in situ
    - Identify features to remove – old pipes, concrete, fencing, roads/trails, etc.
- Consider the following questions from Beechie et al. 2008:

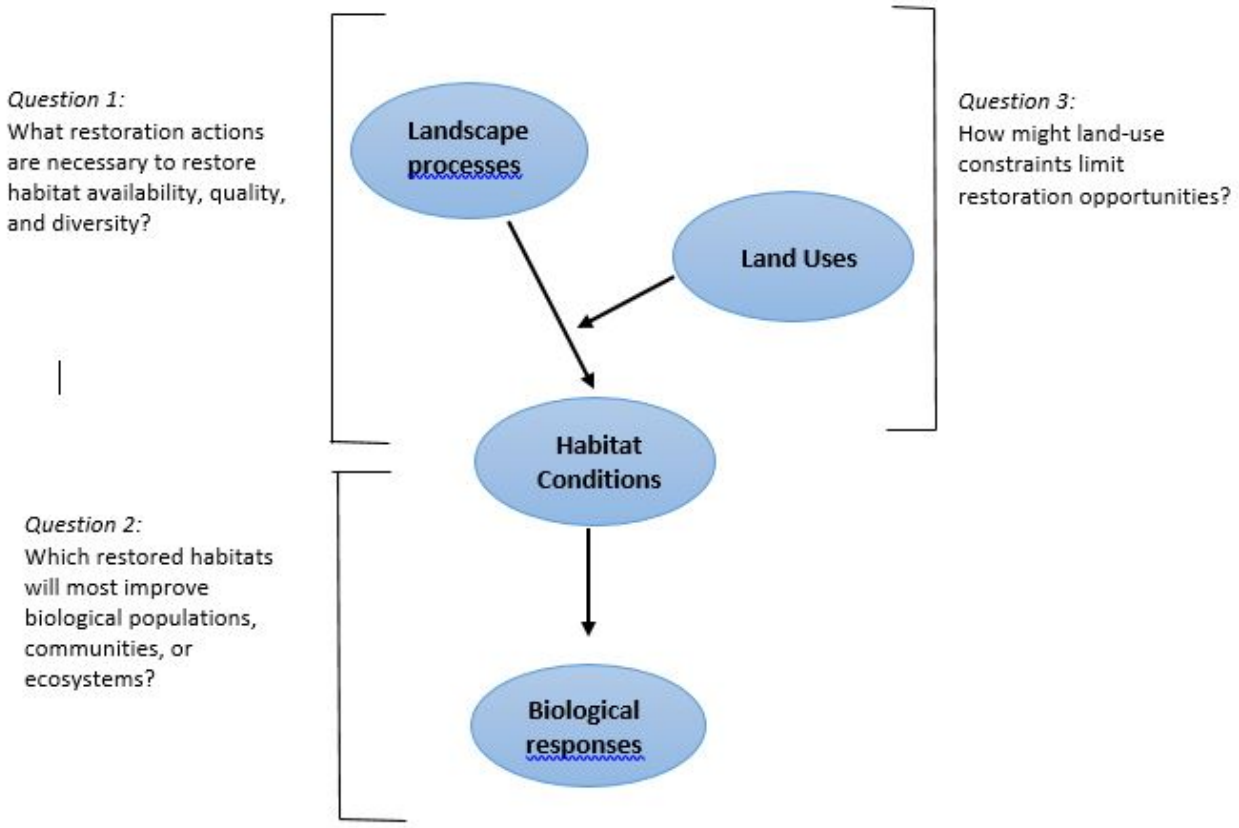

Figure 2. Diagram of conceptual linkages and questions to be addressed in assessments used to identify and prioritize restoration actions (Beechie et al. 2008).

Identify and appraise options: A number of potential options should be considered and appraised in order to provide a robust basis upon which to make a decision on how to move forward. All feasible options and flexible tools should be assessed and clearly described in relation to the baseline (no action) to provide decision makers and partners all the necessary information to base their decisions.
In addition, impacts of all options should be described and assessed. This includes impacts on all stakeholders, both positive and negative. Impacts should be screened for relevance and significance and can be assessed qualitatively or quantitatively where enough information is available to support the assessment.

In summarizing the results of the options, costs and benefits should be aggregated across relevant categories to provide a consistence basis for assessment. Comparisons should be consistent and any uncertainties should also be described and addressed.

- Can the restoration treatment meet and fulfill the objectives for the project?
- What are the chances of success?
- Does it address the causes rather than the symptoms?
- Consider the consequences of taking no action, assess the risks, costs, and benefits of implementing each option.

No Treatment: allows the natural adjustment of a system and therefore is the most sustainable. Should be applied when natural processes are likely to constitute a natural solution to the problem and the system has the ability to adjust (all processes functioning and no anthropogenic constraints).
Management Option(s)/Restoration Activities: Based on addressing the causes of the problem. This option involves restoration treatments to improve existing conditions.

Restoration activities should be developed and prioritized at the forest and district level in collaboration with partners.

Prioritization:
Four primary considerations could be used to prioritize locations and timing of aquatic and watershed restoration activities: watershed condition framework, corresponding vegetation restoration activities, partner interest, and presence of federally-listed or candidate species.

Activities that may be identified within a proposed vegetation treatment area include, but are not limited to: thinning conifers along and within riparian areas, restoring incised channels, riparian planting, removing/obliterating unauthorized routes, and/or putting in drainage and closing level 1 system roads after all treatments are completed.

Prioritization of aquatic and watershed restoration projects will depend upon multiple site specific factors. Therefore, we list considerations when prioritizing activities rather than requirements.

Table 1. Considerations for prioritizing where and when treatments are implemented.

Watershed Condition Framework and priority watersheds.	Areas or activities within existing Watershed Restoration Action Plans can increase opportunities to move watersheds into a higher condition class. Maintaining or improving watershed condition where feasible should be taken into consideration. Projects in priority watersheds should be considered.
Projects that improved impaired waters	Projects that improve water quality in ADEQ TMDL (water quality improvement plan) or 303b listed streams,
Vegetation restoration activities within the area.	Incorporating aquatic and watershed restoration activities in an area with other restoration treatments whenever possible is one way to create efficiencies with heavy equipment and personnel.
Partner Interest	Projects that already have partners or interested partners, particularly if funding is available, should be considered.
Presence of federally listed or candidate species	The presence of these species and improving their habitat could increase the prioritization of a project over a site that had none present.
Wet meadows, cienegas, and other similar habitats.	These habitat types store water in upper watersheds and maintain baseflow to other aquatic habitats. They also cool water and can provide for lower stream water temperatures. Maintaining and improving these areas can have great downstream beneficial impacts.
Upper watershed vs. lower	Restoration in upper portions of watersheds can have beneficial impacts downstream such as reduced sedimentation, maintaining baseflow, and cooling stream temperatures. They will have a larger range of beneficial impacts than projects lower in a watershed.

Issues that are new, easily treated, or could quickly spread.	Newer issues have not yet caused that much damage; restoration treatments of these are more cost and time effective as well as preventing more degradation. Projects such as these are 'low-hanging fruit' when compared to larger or more widespread issues. In addition, new infestations of noxious weeds or aquatic invasive plants are easier to treat early rather than after they spread.
Force account, contracted, and partner implementation	All three categories have merit, but may have differing financial or oversight costs. These should be considered differently amongst options and assessed. Prioritization may depend upon which category a project occurs in when weighed against work load, capacity, and financial considerations.
Process versus form-based projects	Projects that enhance site conditions, but do not restore the processes that create habitat or site conditions are considered form-based. These types of projects can require more maintenance than projects that restore the processes that create and maintain habitat. Projects that restore processes may be more of a priority than those that address a specific issue rather than the larger problem.

Implementation of the treatment:

Consultation and Implementation:

Pre-implementation surveys will be conducted for Endangered Species Act and sensitive species, rare plants, invasive species, and cultural resources. If federally-listed, rare, or sensitive species, or cultural sites, are found during pre-implementation surveys or during activity implementation, the appropriate mitigation will be incorporated into activity design. Any cultural resource findings will be coordinated with the State Historical Preservation Office.

Validation and Collaboration Period:

Activities will include written specific activity descriptions and associated design criteria. The Implementation Checklist (Appendix D of the EIS, and stand-alone Implementation Plan) will be used to ensure each activity is consistent with the Rim Country analysis and within the scope of the decision. Pre-project notification will be reported to all required regulatory agencies at least 60 days prior to implementation of the activity.

Monitor and evaluate: The impacts are monitored in order to appraise them against initial objectives of the project. The information should be used to ensure the project is consistent with the assumptions, analysis and biological opinion for the project. It should also be used to inform future restoration treatment decisions on maintenance and adaptive management.

Restoration treatments in the flexible toolbox:

The first set of tables below describe existing conditions and resource concerns for general types of aquatic systems in the toolbox. The second set of tables list the restoration tools grouped by the general set of resource concerns they address.

Springs:

Existing Condition (what, where, how much?)	Resource Issues and Concerns	See Tools for:
Surface flow impacted by hydrological drought, alteration of the source or outflow, springbox, diversion or piping.	Reduced surface and subsurface flows from human created diversions, piping and alterations reduce habitat for aquatic, wetland and riparian obligate species; plants and animals.	Improving spring outflows
Channeling or degraded outflow channels are degraded leading to reduced surface and/or subsurface flow.	Reduced surface and subsurface flows reduce habitat for aquatic, wetland and riparian obligate species; plants and animals.	Improving spring outflows and/or form and function of stream channels and floodplains
Invasive or noxious plants are present and competing with native vegetation.	Native plants are outcompeted or overtaken, habitat degraded, loss or decline of native species.	Improving native riparian or aquatic vegetation
Developed spring is splitting flow from a failing springbox, diversion or piping.	Diversion of flow is dewatering the outflow and associated wetlands.	Improving spring outflows
Riparian or aquatic vegetation and proper soil function is impacted by recreation or overgrazing by livestock or elk.	Loss or decline of native and/or rare wetland, riparian, and aquatic plant species. Plant composition has low similarity compared to historic range of variability. Reduction or loss of habitat.	Improving native riparian or aquatic vegetation
User created trails or roads are impacting wetland and associated vegetation.	Loss or decline of native and/or rare wetland, riparian, and aquatic plant species. Loss or decline of vegetative ground cover and increases in bare soil exposure. Soil compaction and subsequent accelerated erosion causing degradation of proper soil function and site productivity. Potentially leading to altered surface or subsurface flows. Reduction or loss of habitat.	Improving road or trail interactions
Spring is being encroached by upland species or undesirable native species.	Loss or decline of native and/or rare wetland, riparian, and aquatic plant species. Reduction or loss of spring habitat.	Improving native riparian or aquatic vegetation

Wetlands (marshes, potholes, wet meadows, and natural ponds):

Existing Condition (what, where, how much?)	Resource Issues and Concerns	See Tools for:
Wetland is impacted by invasive plant species	Loss or decline of native and/or rare wetland, riparian, and aquatic plant species. Plant composition has low similarity compared to historic range of variability. Reduction or loss of habitat.	Improving native riparian or aquatic vegetation.
Encroachment by upland species or undesirable native species.	Encroachment is identified as an indicator of lowered water table, loss or decline of native and/or rare wetland, riparian, and aquatic plant species.	Improving native riparian or aquatic vegetation.
Vegetation and soils may be impacted by excessive livestock or elk herbivory, unauthorized routes, etc.	Loss or decline of native and/or rare wetland, riparian, and aquatic plant species. Loss or decline of vegetative ground cover and increases in bare soil exposure. Soil compaction and subsequent accelerated erosion causing degradation of proper soil function and site productivity. Potentially leading to altered surface or subsurface flows. Reduction or loss of habitat.	Improving native riparian or aquatic vegetation.
Evidence of incision, slumping, excessive soil erosion/sedimentation or other such issues that are draining the wetland.	Reduced surface and subsurface flows draining the wetlands, narrowing or loss of wetland, riparian, and aquatic plant species. Reduction or loss of habitat.	Improving form and function of stream channels and floodplains.
Poorly located or user created roads and trails causing degradation to soil function and site productivity.	Streams or wetlands have increased sedimentation, increased erosion, accelerated peak flows and loss or degraded vegetation from user created roads or trails.	Improving road or trail interactions.

Montane meadows:

Existing Condition (what, where, how much?)	Resource Issues and Concerns	See Tools for:
Native vegetation is impacted by invasive plant species	Loss or decline of native plant species. Plant composition has low similarity compared to historic range of variability. Reduction or loss of habitat.	Improving native riparian or aquatic vegetation.
Encroachment by upland species or undesirable native species.	Encroachment is an indicator of lowered water table, loss or decline of native plant species.	Improving native riparian or aquatic vegetation.
Vegetation and soils may be impacted by excessive livestock or elk herbivory, unauthorized routes, OHV use, camping, etc.	Loss or decline of vegetation and ground cover, increases in bare soil exposure. Soil compaction and subsequent accelerated erosion causing degradation of proper soil function and site productivity. Potentially leading to altered surface or subsurface flows. Reduction or loss of habitat.	Improving native riparian or aquatic vegetation.
Evidence of incision, slumping, excessive soil erosion/sedimentation or other such issues that are draining the meadow.	Reduced surface and subsurface flows draining the meadows. Reduction or loss of habitat.	Improving form and function of stream channels and floodplains.
Poorly located or user created roads and trails causing degradation to soil function and site productivity.	Increased sedimentation, erosion, and accelerated peak flows from user created roads or trails.	Improving road or trail interactions.

Unneeded Roads and Unauthorized Routes and Trails:

Existing Condition (what, where, how much?)	Resource Issues and Concerns	See Tools for:
Poorly located or user created roads and trails causing excessive soil disturbance, erosion and soil compaction.	Soil compaction and erosion. Soil compaction and subsequent erosion causing increased sedimentation if road networks are connected to stream channels.	Improving road or trail interactions.
Stream or wetland damage due to poorly located or user created roads within the floodplain, wet meadow, spring outflow, or other such wetland habitats.	Confinement of stream channel, degradation of wetlands, erosion into aquatic habitats, draining of wetlands, channel widening.	Improving road or trail interactions and/or form and function of stream channels and floodplains
Need for frequent maintenance that impacts aquatic and watershed resources.	Concentration of flows that were originally spread across a wide area via drainage capture by ditching or berms. Potential changes in peak flows.	Improving road or trail interactions and/or form and function of stream channels and floodplains.
	Impacts to active channel or flood plain dimension that alters function (energy dissipation or sediment transport).	Improving road or trail interactions and/or form and function of stream channels and floodplains.

Road and Stream or Wetland Crossings:

Existing Condition (what, where, how much?)	Resource Issues and Concerns	See Tools for:
Road crossings are increasing sedimentation to streams, springs, wet meadows, and other wetlands. Road crossings are causing excessive soil erosion/sedimentation that may be impacting nearby downstream vegetation stability/productivity.	Increased sedimentation to aquatic systems degrading spawning habitat, reducing macroinvertebrate and algae food base. Loss or decline of native wetland vegetation and proper soil stability/productivity downstream from road crossing	Improving road or trail interactions and/or form and function of stream channels and floodplains.
Roads and associated stream crossings are changing the character of flow across the landscape, such as concentrating flows into a culvert.	Alteration of flows/hydrology within a stream valley is causing channel incision.	Improving road or trail interactions and/or form and function of stream channels and floodplains.
Road crossings are causing geomorphic changes to stream channels such as stream widening.	Roads may cause widening of channels which can cause increased stream temperatures, alterations to the channel, and degraded stream habitat. Undersize culverts may cause an increase in stream velocity causing scour and downcutting.	Improving road or trail interactions and/or form and function of stream channels and floodplains.
Road crossing geometry is impairing sediment transport capacity and competency.	Alteration of sediment transport is causing long-term aggradation/degradation of the stream channel.	Improving road or trail interactions and/or form and function of stream channels and floodplains.
Aquatic organism passage (where it is meant to exist) is completely or partially impeded due to lack of stream flow, perched culverts, degraded culverts or other such issues.	Aquatic organisms cannot pass part or all of the time impeding migration, genetic flow, distribution, and access to refuge habitats.	Improving road or trail interactions and/or form and function of stream channels and floodplains.
Roads are impacting stream and wetland plant communities through physical disturbance and soil compaction.	Roads may cause vegetation trampling, soil cover loss and soil compaction that can lead to decreased diversity of native species, loss of ground cover, and invasion of exotic species.	Improving road or trail interactions and/or form and improving native and riparian vegetation.

Streams (Channels, Floodplains and Riparian):

Existing Condition (what, where, how much?)	Resource Issues and Concerns	See Tools for:
Stream habitat complexity is lacking, where it should exist, in relation to all aquatic species life stages (e.g. rearing and juvenile habitat). • Most stream habitat is riffles or runs with little to no pool habitat and pool cover. Pool to riffle ratio is low. • Large woody debris and recruitment is not present to create instream habitat complexity and cover. • Spawning habitat for various species (i.e. clean gravel bars, clean sand) are lacking. • Stream substrate is compacted or becoming cemented (i.e., tightly packed). Stream substrate is covered in fine sediment above natural levels.	Aquatic species need a variety of habitats to complete their life cycle. • Pool habitat is critical for resting habitat and thermal refugia for many species of fish • Lack of large woody debris contributes to poor stream habitat diversity. • Spawning habitat is essential to maintaining fish populations. • Cemented substrate affects habitat availability for small bodied fish, macroinvertebrate habitat, and spawning habitat. Decreased pool depth and cover	Improving form and function of stream channels and floodplains.
Stream temperatures are high or reaching thermal tolerance of aquatic species.	Many aquatic species in the southwest are living at the edge of their thermal tolerance, drought conditions or warming temperatures may make habitats unsuitable.	Improving form and function of stream channels and floodplains and/or native riparian or aquatic vegetation
Stream has or is currently incising and no longer connects with its floodplain or historic channels. Streambanks are incised or laterally unstable, and/or historic channels are abandoned.	Floodplain connection is critical for maintaining stream geomorphic function, stream habitat diversity, recharge of groundwater sources, and maintenance of riparian vegetation. Laterally unstable banks are causing high erosion and sedimentation rates that alter aquatic and riparian habitat quality. Sediment transport is also affected. Historic channels provide habitat for varying ages classes of species, dissipate flood flows, provide riparian and aquatic habitat.	Improving form and function of stream channels and floodplains
Stream is confined; it has been straightened or confined.	Artificially confined streams may not function properly. Confinement may cause incision or other issues due to	Improving form and function of stream channels and floodplains

Existing Condition (what, where, how much?)	Resource Issues and Concerns	See Tools for:
	changes in stream power and sediment transport. These areas often have issues during flood flows.	
Stream width and depth ratio is inappropriate for stream type.	Overly wide streams may lack pools and habitat diversity and have higher stream temperatures than streams with a lower width depth ratio. Conversely, artificially confined streams may be not be able to dissipate stream energy.	Improving form and function of stream channels and floodplains
Hydrologic cycles are altered leading to reduced flood flows, or increased frequency of high flows (e.g. post fire flooding).	Aquatic and riparian species are adapted to certain hydrologic cycles which can be important to their life cycles. Flood flows are essential for maintaining properly functioning stream channels, floodplains and substrate distribution.	Improving form and function of stream channels and floodplains
Streams and associated floodplains are not dissipating flood water energy causing damage to streambanks. Meander pattern altered.	Altered channel roughness or meander pattern is causing excessive erosion, limiting energy dissipation from high flows, changes to channel morphology, altering stream habitat and floodplains.	Improving form and function of stream channels and floodplains
Water quality is poor due to turbidity, sedimentation, or other factors other than temperature.	Poor water quality can cause a shift in macroinvertebrate and fish assemblages to more disturbance tolerant species. It can also alter primary or secondary productivity leading to changes in food availability.	Improving form and function of stream channels and floodplains
Large woody debris is not present in channels or wetlands to reduce stream energy, provide cover, and create complex habitat.	Lack of large woody debris recruitment to streams reduces roughness, cover, and habitat complexity.	Improving form and function of stream channels and floodplains
Riparian communities are not functioning at potential to support geomorphic and biotic needs of the aquatic community. • Leaf litter from riparian vegetation (allochthonous material) is lacking. • Existing riparian woody vegetation is lacking or out competed by conifers.	Riparian communities (both woody and herbaceous) are essential to the health of instream aquatic systems. • Organic matter (leaves) provide nutrients and food source for macroinvertebrates, prey species for fish. • Loss or decline of riparian vegetation, stream shade, and bank stability.	Improving form and function of stream channels and floodplains and/or improving native riparian vegetation

Existing Condition (what, where, how much?)	Resource Issues and Concerns	See Tools for:
• Floodplain vegetation has converted to upland species. • • Riparian area is narrowing. • Soil compaction and accelerated soil erosion/sedimentation and bank instability.	• Riparian vegetation aids in flood resilience, dissipation of flows (roughness), large woody debris and bank stability for stream systems. • Narrowing riparian area could indicate reduced water table, disconnected floodplain, or other constraints leading to loss of bank stability, shade, large woody debris, and possibly reduced flows. • Decreased soil function leading to stream bank soil instability and reduced site productivity of desirable native, riparian vegetation.	

Flexible Toolbox: Tools described by general type of resource issues or concerns they may address.

Tools for Improving Native Riparian or Aquatic Vegetation:

Tools	Resource Issues or Concerns Addressed
Removing tree(s), tree canopy, or shrub encroachment of upland species with hand thinning, mechanical thinning or prescribed fire.	Loss or decline of wetland, riparian, or aquatic plant species. Indicators of drying that can be associated with past land management practices
Remove and manage noxious or invasive plants using hand methods or herbicides as described in forest weed management plans.	Loss or decline of native and/or rare wetland, riparian, and aquatic plant species. Protection or restoration of existing native biodiversity, erosion control, wildlife forage and habitat.
Plant native aquatic or riparian plant species by hand or mechanically, including seeding.	Loss or decline of native and/or rare wetland, riparian, and aquatic plant species, increased bank stability and leaf litter. Loss of site diversity and proper soil function.
Protect and promote existing native aquatic or riparian plant species. Site protection or fencing, which could be for seasonal restrictions, temporary restrictions, or year round. Install fencing, remove/relocate roads or trails, create defined trails for recreation management using manual or mechanical tools.	Promote plant growth and vigor, reduce erosion and sediment inputs to aquatic systems, removal of riparian or aquatic stressors. Reduce ungulate grazing, excessive soil disturbance, OHV impacts, created trails, and dispersed camping causing resource damage. Reduce erosion, bank instability
Prescribed burning.	Natural disturbance leading to regeneration of riparian plant species, reduction in fuel loading and fuel corridors.

Tools for Improving Spring Outflows:

Tools	Resource Issues or Concerns Addressed
Improve or remove boxes or other infrastructure, using excavation, shovels, trackhoes, jackhammers, concrete saw to restore natural spring function. Remove unneeded channels to consolidate spring outflow and increase habitat.	Spring developed for irrigation or livestock that is no longer needed and is compatible with existing water rights.. Restoring natural spring function and flow
Split flow in developed springs to allow water above existing water rights to be released to spring outflows. Hand methods for fixing springboxes, piping, or diversions to split spring flow.	Drying of spring outflow, reduced aquatic and riparian vegetation, reduced habitat, reduced soil function, spring not functioning properly
Protect spring emergence zone and/or springbrook from direct ungulate disturbance through fencing.	Loss and/or degradation of wetland and riparian species from concentrated ungulate use of spring emergence zone and/or springbrook

Tools for improving road or trail interactions with stream courses, springs, or other wetlands:

Tools	Resource Issues or Concerns Addressed
Obliterate roads restoring natural contours and vegetation using mechanical roads treatments.	For existing roads causing resource damage such as confining a stream, draining wetlands, loss or degradation of riparian or aquatic vegetation and habitat, and loss or degradation to proper soil function.
Close and restore unauthorized roads, trails, and dispersed camping areas using mechanical roads treatments.	For unauthorized roads, trails or recreational impacts causing resource damage such as confining a stream, draining wetlands, loss or degradation of riparian or aquatic vegetation and habitat, and loss or degradation to proper soil function.
Return ML 1 roads to closed status after use for restoration treatments by removal of drainage infrastructure (e.g., culverts), reestablishment of road drainage through leadout ditches, water bars, rolling dips, and other means, removal of unstable fill, , and placement of slash using mechanical roads treatments.	Erosion, sedimentation, degradation or loss of vegetation from ML 1 roads.
Armor downstream culvert outlets using mechanical roads treatments.	Increased erosion and scouring downstream of culverts, bank instability, and channel downcutting.
Upsizing culverts using mechanical roads treatments.	Streams scouring around culverts and over roads, increased erosion to streams or wetlands, reduced aquatic organism passage from road culverts. Potential impacts to channel soil stability and site productivity.
Installing or adding culverts or culvert arrays using mechanical roads treatments.	Loss of stream connectivity, channel width, erosion and sedimentation to streams, channelization and increased channel width due to roads. Potential impacts to channel soil stability and site productivity.
Maintaining Aquatic Organism Passage where it exists if road work needed. – Install bridge, replace culvert, or remove crossing using mechanical roads treatments.	Decreased fish passage, habitat access, passage of high flows and bedload, and decreased channel complexity from road culverts.
Install hardened low water crossings or fords (rock, concrete slab, concrete planks, concrete blocks, geocell fords, and vented fords on existing ML1 and ML2 roads needed for mechanical offerings using mechanical roads treatments.	Loss or degradation of riparian vegetation or soil function, channel widening, increased erosion, sedimentation to aquatic habitats, increased bank instability from roads crossing streams or wetlands.
Install and replace bridges on ML1 and ML2 roads needed for mechanical offerings using mechanical roads treatments.	Decreased aquatic and wildlife passage through culverts or under exiting bridges, deposition of stream bedload upstream of culverts, high flows are scouring channel and floodplain upstream, log jams are forming upstream of culverts or bridges.
Raise culverts where invert elevations have resulted in stream incision.	Restore natural flow paths and connection of flow to floodplain areas.
Install raised permeable roadbeds with or without culverts where roads cross areas of seasonal or perennial water inundation.	Restore natural flow paths.
Restore channels affected by road crossings using mechanical roads treatments.	Channel widening, erosion and sedimentation upstream or downstream of a road crossing. Loss or degradation of riparian vegetation and soil function.

Decommission or relocate ML1 and ML2 roads needed for mechanical offerings causing resource damage to springs, wetlands or streams using mechanical roads treatments.	Reduce sedimentation and erosion, improve vegetation and soil condition, restore stream banks, restore and improve aquatic and terrestrial habitat.
Developing footpath(s) on existing trails to prevent further erosion using hand or mechanical treatments.	Streams, springs, or wetlands have increased sedimentation, increased erosion, and loss or degraded vegetation and soil condition from user created trails.

Tools for improving the form and function of stream channels and floodplains:

Tools	Resource Issues or Concerns Addressed
Large woody debris, log Structures, log jams, yarding trees. Tree falling, transport and placement of trees and root wads from somewhere else, yarding over trees, helicopter wood, mechanical installation.	Floodplain connection is critical for maintaining stream geomorphic function, soil stability, stream habitat diversity, recharge of groundwater sources, and maintenance of riparian vegetation. Sediment transport is also affected. Lack of large woody debris recruitment to streams for reduces roughness, cover, and habitat complexity.
Weirs and Beaver Dam Analogs (BDAs) installed by hand or mechanical methods.	Floodplain connection is critical for maintaining stream geomorphic function, soil stability, stream habitat diversity, recharge of groundwater sources, and maintenance of riparian vegetation. Sediment transport is also affected.
Wicker, log and rock wires, vanes, or baffles, brush bundles and root wads using various methods and installed by hand or mechanically.	Lack of channel roughness or meanders is causing excessive erosion, changes to channel morphology, altering stream habitat and floodplains.
Boulder and log deflectors using mechanized installation.	Lack of channel roughness or meanders is causing excessive erosion, changes to channel morphology, altering stream habitat and floodplains. Lack of pool habitat or instream cover.
Hand girdling trees to provide for future large woody debris stream input.	Lack of large woody debris recruitment to streams for reduces roughness, cover, and habitat complexity.
Restoring meanders or adding stream length by induced meandering, recontouring the channel, plug and pond, other similar methods mechanically.	Artificially confined streams may not function properly. Confinement may cause incision or other issues due to increased stream power and sediment transport. These areas often have issues during flood flows.
Channel reconstruction, realignment or floodplain reconnection using mechanical treatments.	Floodplain connection is critical for maintaining stream geomorphic function, soil stability, stream habitat diversity, recharge of groundwater sources, and maintenance of riparian vegetation. Sediment transport is also affected.
Flood plain creation, widening, or laying back incised stream banks using mechanical treatments.	Floodplain connection is critical for maintaining stream geomorphic function, soil stability, stream habitat diversity, recharge of groundwater sources, and maintenance of riparian vegetation. Sediment transport is also affected
Removing instream stock tanks and replacing with guzzlers, drinkers, etc. in the uplands using mechanical treatments	Restore channel width, sediment, flow, and water source for downstream areas.
Zuni bowls, one rock dams or other similar methods using mechanical or hand treatments.	Slow overland flow or stream flow in small channels, reduce erosion and sedimentation.

Reconnection of historic side channels that should be functioning using mechanical treatments.	Floodplain connection is critical for maintaining stream geomorphic function, soil stability, stream habitat diversity, recharge of groundwater sources, and maintenance of riparian vegetation. Sediment transport is also affected.
Maintenance of existing structures using manual or mechanical treatments.	Structures that stabilize banks, create instream cover and channel roughness, etc. from the CCC era forward currently exist on the landscape.
Removing existing erosion control structures	Removing poorly placed or nonfunctional structures can improve channel form and function.

The tools listed above for aquatic and watershed restoration activities would not be used universally across the project area. In general, the tools all have circumstances where they would be more successful in moving the restoration project toward desired condition. Some tools have circumstances where they would not generally apply as they would be ineffective, not needed, or potentially cause degradation rather than improving conditions. Listed below are the general circumstances under which each tool would apply or conversely, where they would not apply. The generalized circumstances table is intended to provide general implementation guidance for the tools as well as to better define where these proposed activities could occur for Rim Country.

Characteristics that could be mapped such as stream gradient and road maintenance levels were used to greatest extent possible. However, some characteristics such as presence of ungulate impacts or presence of noxious or invasive plants cannot be defined using remote sensing techniques and will still need to be determined on site Applicability based on stream gradient was determined using Rosgen stream types as well as literature on specific tools.

Generalized circumstances for when or where tools would or would not apply:

Treatments/Tools	Circumstances where treatments would apply	Circumstances where treatments would not apply
Removing tree(s), tree canopy, or shrub encroachment of upland species with hand thinning, mechanical thinning or prescribed fire.	In low and medium gradient stream reaches where wetland, riparian, or aquatic plant species should be present.	In stream reaches where upland species are the dominant plant species. High gradient stream reaches.
Remove and manage noxious or invasive plants using hand methods or herbicides as described in forest weed management plans.	Anywhere that noxious or invasive plants are impacting native riparian or aquatic vegetation.	Anywhere noxious or invasive plants do not occur.
Plant native aquatic or riparian plant species by hand or mechanically, including seeding.	In low and medium gradient stream reaches and all other wetland types where wetland, riparian, or aquatic plant species should be present.	High gradient stream reaches
Protect and promote existing native aquatic or riparian plant species. Site protection or fencing, which could be for seasonal restrictions, temporary restrictions, or year round. Install fencing, jack straw, remove/relocate roads or trails, create defined trails for recreation management using manual or mechanical tools.	In low and medium gradient stream reaches where wetland, riparian, or aquatic plant species should be present. Areas would also have to be reasonably close to road system for access and maintenance.	High gradient stream reaches, narrow or confined valleys.

Treatments/Tools	Circumstances where treatments would apply	Circumstances where treatments would not apply
Improve or remove spring boxes and other infrastructure, using excavation, shovels, trackhoes, jackhammers, concrete saws to restore natural spring function. Removing unneeded channels to consolidate spring outflow and increase habitat.	Low to moderate gradient stream reaches	
Split flow in developed springs to allow water above existing water rights to be released to spring outflows. Hand methods for fixing springboxes, piping, or diversions to split spring flow.	Low to moderate gradient stream reaches	
Protect spring emergence zone and/or springbrook from direct ungulate disturbance through fencing.	In areas where ungulate disturbance is impacting springs.	Where ungulate disturbance is not a causative factor.
Obliterate roads restoring natural contours and vegetation using mechanical roads treatments.	Where existing roads causing resource damage such as confining a stream, draining wetlands, loss or degradation of riparian or aquatic vegetation and habitat, and loss or degradation to proper soil function.	
Close and restore unauthorized roads, trails, and dispersed camping areas using mechanical roads treatments.	For unauthorized roads, trails or recreational impacts causing resource damage such as confining a stream, draining wetlands, loss or degradation of riparian or aquatic vegetation and habitat, and loss or degradation to proper soil function.	
Return ML 1 roads to closed status after use for restoration treatments by removal of drainage infrastructure (e.g., culverts) , reestablishment of road drainage through leadout ditches, water bars, rolling dips, and other means, removal of unstable fill, , and placement of slash using mechanical roads treatments.	Anywhere that ML1 roads are opened for use within Rim Country.	
Armor downstream culvert outlets using mechanical roads treatments.	ML 2-4 roads where erosion is occurring from culverts.	
Upsizing culverts using mechanical roads treatments.	ML 2-4 roads in areas where stream or overland flow had increased above the capacity of existing infrastructure.	
Installing or adding culverts or culvert arrays using mechanical roads treatments.	ML 2-4 roads in areas where stream or overland flow had increased above the capacity of existing infrastructure.	
Maintaining Aquatic Organism Passage where it exists if road crossing work needed. – Install bridge, replace	Where roads and streams intersect on ML 2-4 roads	ML 1 and ML 5 road/stream crossings or intersections.

Treatments/Tools	Circumstances where treatments would apply	Circumstances where treatments would not apply
culvert, or remove crossing using mechanical roads treatments.		
Install hardened low water crossings or fords (rock, concrete slab, concrete planks, concrete blocks, geocell fords, and vented fords on existing ML1 and ML2 roads needed for mechanical offerings using mechanical roads treatments.	Where ML 1-2 roads intersect with streams	ML 3-5 road and stream intersections
Install and replace bridges on ML1 and ML2 roads needed for mechanical offerings using mechanical roads treatments.	Where ML 1-2 roads intersect with streams	ML 3-5 road and stream intersections
Developing footpath(s) or tread on existing trails to prevent further erosion using hand or mechanical treatments	Where trails are within 250 feet from streams	Trails beyond 250 feet from streams.
Large woody debris, log structures, log jams, yarding trees. Tree falling, transport and placement of trees and root wads from somewhere else, yarding over trees, helicopter wood, mechanical installation.	Low to moderate gradient stream reaches and valleys, with wide to narrow floodplains.	High gradient stream reaches
Weirs and Beaver Dam Analogs (BDAs) installed by hand or mechanical methods.	Low to moderate gradient stream reaches and valleys (most viable at stream slopes of 0-3%), with wide to narrow floodplains.	High gradient stream reaches. BDAs are less viable at stream slopes of >3%.
Wicker, log and rock wires, vanes, or baffles, brush bundles and root wads using various methods and installed by hand or mechanically.	Low to moderate gradient stream reaches and valleys, with wide to narrow floodplains.	High gradient stream reaches.
Boulder and log deflectors using mechanized installation.	Low to moderate gradient stream reaches and valleys, with wide to narrow floodplains.	High gradient stream reaches
Hand girdling trees to provide for future large woody debris stream input.	Low to moderate gradient stream reaches and valleys, with wide to narrow floodplains.	High gradient stream reaches
Restoring meanders or adding stream length by induced meandering, recontouring the channel, plug and pond, other similar methods mechanically.	Low to moderate gradient stream reaches and valleys, with wide to narrow floodplains. Wetlands and wet meadows.	High gradient stream reaches
Channel reconstruction, realignment or floodplain reconnection using mechanical treatments.	Low to moderate gradient stream reaches and valleys, with wide to narrow floodplains.	High gradient stream reaches
Flood plain creation, widening, or laying back incised stream banks using mechanical treatments.	Low to moderate gradient stream reaches and valleys, with wide to narrow floodplains.	High gradient stream reaches
Removing instream stock tanks and replacing with guzzlers, drinkers, etc. in the uplands using mechanical treatments	Low to moderate gradient stream reaches and valleys.	High gradient stream reaches

Treatments/Tools	Circumstances where treatments would apply	Circumstances where treatments would not apply
Zuni bowls, one rock dams or other similar methods using mechanical or hand treatments.	Low to moderate gradient stream reaches and valleys.	High gradient stream reaches
Reconnection of historic side channels that should be functioning using mechanical treatments.	Low to moderate gradient stream reaches and valleys.	High gradient stream reaches
Maintenance of existing structures using manual or mechanical treatments.	Generally found in low to moderate gradient stream reaches and valley slopes.	High gradient stream reaches
Removing existing erosion control structures	Generally found in low to moderate gradient stream reaches and valley slopes.	High gradient stream reaches

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Appendix C: Forest Plan Consistency

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
Apache-Sitgreaves				
Overall Ecosystem Health	DC 4	Ecological conditions for habitat quality, distribution, and abundance contribute to self-sustaining populations of native and desirable nonnative plants and animals that are healthy, well distributed, connected, and genetically diverse. Conditions provide for the life history, distribution, and natural population fluctuations of the species within the capability of the landscape.	Habitat quality by increasing sedimentation and increased road density	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads. Long term benefits associated with moving towards desired conditions, reducing catastrophic fire risk, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Overall Ecosystem Health	DC 7	Habitat quality, distribution, and abundance exist to support the recovery of federally listed species and the continued existence of all native and desirable nonnative species.	Habitat quality by increasing sedimentation and increased road density.	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Water Resources	DC 20	Water quality, stream channel stability, and aquatic habitats retain their inherent resilience to natural and other disturbances.	Habitat quality by increasing sedimentation	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Water Resources	DC 22	Vegetation and soil conditions above the floodplain protect downstream water quality, quantity, and aquatic habitat.	Habitat quality by increasing sedimentation, reduction in riparian canopy cover	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Water Resources	DC 23	Instream flows provide for channel and floodplain maintenance, recharge of riparian aquifers, water quality, and minimal temperature fluctuations.	Habitat quality by increasing sedimentation, increased risk of introduction/spread of aquatic	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with decommissioning and relocating roads, improving stream, wetland, and riparian habitat.

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
			invasive species or disease.	
Water Resources	DC 24	Streamflows provide connectivity among fish populations and provide unobstructed routes critical for fulfilling needs of aquatic, riparian-dependent, and many upland species of plants and animals.	Stream habitat connectivity	Negative short term impacts associated with existing roads, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with decommissioning and relocating roads, improving stream, wetland, and riparian habitat as well as connectivity.
Water Resources	DC 26	Stream channels and floodplains are dynamic and resilient to disturbances. The water and sediment balance between streams and their watersheds allow a natural frequency of low and high flows.	Habitat quality by increasing sedimentation and road density	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads. Beneficial impacts associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Water Resources	DC 27	Stream condition is sufficient to withstand floods without disrupting normal stream characteristics (e.g., water transport, sediment, woody material) or uncharacteristically altering stream dimensions (e.g., bankfull width, depth, slope, sinuosity).	Habitat quality by increasing sedimentation	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Water Resources	DC 30	Water quality meets the needs of desirable aquatic species such as the California floater, northern and Chiricahua leopard frog, and invertebrates that support fish populations.	Habitat quality by increasing sedimentation, increased risk of introduction/spread of aquatic invasive species or disease.	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving stream, wetlands, and riparian habitat.
Water Resources	GL 6	Projects with ground-disturbing activities should be designed to minimize long and short term impacts to water resources. Where disturbance cannot be avoided, project specific soil and water conservation practices and best management practices (BMPs) should be developed.	Habitat quality by increasing sedimentation	Project mitigations for timing, slope, and spatial extent of ground disturbing activities allowed (AQ032, FE013, RM004 SW001, SW002, SW004, SW005, SW007, SW017, SW018, SW027, SW032, SW033, SW034, SW041, SW044, SW045, SW046, SW048, SW049, SW050, SW051, SW052, SW053, SW054, SW057, SW058, SW060, SW063, SW066, SW069, SW079, SW100, TR014). Minimizing temporary road and road

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
				decommissioning impacts (AQ006, SW006, SW010, SW043, SW083, SW086, TR002, TR003, TR010, TR014). Stream restoration measures to reduce impacts (AQ008, AQ025, AQ032 AQ033, SW063, SW096, SW097). Skid trail restrictions (SW032-047, SW054, SW057, SW060). Rock pit minimization measures (SW108-112, SW125) and fireline criteria (FE008, SW013).
Water Resources	GL 7	Streams, stream banks, shorelines, lakes, wetlands, seeps, springs and other bodies of water should be protected from detrimental changes in water temperature and sediment to protect aquatic species and riparian habitat.	Habitat quality by increasing sedimentation and stream temperature	Project mitigations for primary stream shade zone (AQ035, AQ037, AQ038, SI001, SI008). Minimizing temporary road and road decommissioning impacts (AQ006, SW006, SW010, SW043, SW083, SW086, TR002, TR003, TR010, TR014). Stream restoration measures to reduce impacts (AQ008, AQ025, AQ032 AQ033, SW063, SW096, SW097). Skid trail restrictions (SW032-047, SW054, SW057, SW060). Rock pit minimization measures (SW108-112, SW125) and fireline criteria (FE008, SW013). AMZs and associated guidance: (AQ021, SW001, SW002, SW004-5, SW007-9, SW012-017). Impacts with grazing post-project (RM004, SW017). Yarding mitigations (SW048-53).
Water Resources	GL 8	Aquatic management zones should be in place between streams and disturbed areas and/or road locations to maintain water quality and suitable stream temperatures for aquatic species.	Habitat quality by increasing sedimentation and decreasing canopy cover.	AMZs and associated guidance: (AQ021, SW001, SW002, SW004-5, SW007-9, SW012-017).
Water Resources	GL 13	To protect water quality and aquatic species, heavy equipment and vehicles driven into a water body to accomplish work should be completely clean of petroleum residue. Water levels should be below the gear boxes of the equipment in use. Lubricants and fuels should be sealed such that inundation by water should not result in leaks.	Habitat quality by increasing contaminants	Project mitigations for staging areas away from water, refueling and servicing areas away from water, SWPP plans, checking equipment for leaks, and not allowing contaminants from entering water bodies (AQ026, SW011, SW020-023).
Aquatic Habitat and Species	DC 31	Streams and aquatic habitats support native fish and/or other aquatic species providing the quantity and quality of aquatic habitat within reference conditions	Habitat quality by increasing sedimentation	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
				restoration. Long term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Aquatic Habitat and Species	DC 32	Habitat conditions contribute to the recovery of federally listed species.	Habitat quality by increasing sedimentation	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving streams, wetlands, and riparian habitat.
Aquatic Habitat and Species	DC 33	Streamflows, habitat, and water quality support native aquatic and riparian-dependent species and habitat.	Habitat quality by increasing sedimentation	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving streams, wetlands, and riparian habitat.
Aquatic Habitat and Species	DC 34	Habitat and ecological conditions are capable of providing for self-sustaining populations of native, riparian dependent plant and animal species.	Habitat quality by increasing sedimentation	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving streams, wetlands, and riparian habitat.
Aquatic Habitat and Species	DC 36	Aquatic species habitat conditions provide the resiliency and redundancy necessary to maintain species diversity and metapopulations.	Habitat quality by increasing sedimentation, increased risk of introduction/spread of aquatic invasive species or disease.	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving streams, wetlands, and riparian habitat.
Aquatic Habitat and Species	ST 2	When drafting (withdrawing) water from streams or other water bodies, measures will be taken to prevent entrapment of fish and aquatic organisms and the spread of parasites or disease (e.g., Asian tapeworm, chytrid fungus, whirling disease).	Habitat quality by reducing stream flow, increased risk of introduction/spread of aquatic	Conservation measures for decontamination of equipment and personnel entering any water body (AQ001, AQ031), transferring water between water bodies (AQ0026), and preventing contaminants from entering aquatic habitats (AQ026, SW011, SW020-023).

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
			invasive species or disease.	
Aquatic Habitat and Species	GL 14	Management and activities should not contribute to a trend toward the Federal listing of a species.	Direct impacts and habitat quality/quantity	Species conservation measures to minimize impacts (AQ018-025, FE006 FE009). Project mitigations for decontamination of equipment and personnel entering any water body (AQ001, AQ031), transferring water between water bodies (AQ0026), and preventing contaminants from entering aquatic habitats (AQ026, SW011, SW020-23). Project mitigations for primary stream shade zone (AQ035, AQ037-38, SI001, SI008, SI0012). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts (AQ008, AQ014, AQ025, AQ032-34, SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW0070). AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017).
Aquatic Habitat and Species	GL 15	Activities occurring within federally listed species habitat should apply habitat management direction and species protection measures from recovery plans.	Direct impacts and habitat quality/quantity	Species conservation measures to minimize impacts (AQ018-025, FE006 FE009). Project mitigations for decontamination of equipment and personnel entering any water body (AQ001, AQ031), transferring water between water bodies (AQ0026), and preventing contaminants from entering aquatic habitats (AQ026, SW011, SW020-023).
Aquatic Habitat and Species	GL 17	Sufficient water should be left in streams to provide for aquatic species and riparian vegetation.	Habitat quality by reducing stream flow	Project mitigations for avoiding water withdrawals, taking no more than 10% of stream flow and using fish screens to reduce entrainment (AQ025). Instream isolation zone isolation and capture/release of aquatic species to reduce entrapment during stream restoration (AQ024).
Aquatic Habitat and Species	GL 18	Projects and activities should avoid damming or impounding free-flowing waters to provide	Habitat quality by reducing stream flow	Project mitigations for avoiding water withdrawals, taking no more than 10% of stream flow and using fish screens to reduce entrainment (AQ025). Instream isolation zone

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
		streamflows needed for aquatic and riparian-dependent species.		isolation and capture/release of aquatic species to reduce entrapment during stream restoration (AQ024).
All PNVTs	GL 22	Landscape scale restoration projects should be designed to spread treatments out spatially and/or temporally within the project area to reduce implementation impacts and allow reestablishment of vegetation and soil cover.	Negative impacts associated with compounding treatments	Project mitigations limiting percentage of watershed treated annually and over 5 years to reduce cumulative effects (FW003, FE013, SW079-080, RM004).
All PNVTs	GL 23	Restoration methods, such as thinning or prescribed fire, should leave a mosaic of untreated areas within the larger treated project area to allow recolonization of treated areas by plants, small mammals and insects (e.g., long-tailed voles, fritillary butterflies).	Short term loss of habitat	Project mitigations limiting percentage of watershed treated annually and over 5 years to reduce cumulative effects (FE003, FE013, SW079-080, RM004).
All PNVTs	GL 28	Projects should include quantitative and/or qualitative objectives for implementation monitoring and effectiveness monitoring to assist in moving toward or maintaining desired conditions.		Addressed in the Implementation and monitoring plan.
Riparian Areas	DC 68	Riparian-wetland conditions maintain water-related processes (e.g., hydrologic, hydraulic, geomorphic). They also maintain the physical and biological community characteristics, functions, and processes.	Habitat quality by increasing sedimentation and soil compaction, decreased canopy cover.	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving streams, wetlands, and riparian habitat.
Riparian Areas	DC 72	Ponding and channel characteristics provide habitat, water depth, water duration, and the temperatures necessary for maintaining populations of riparian-dependent species and for their dispersal.	Habitat quality by reduced complexity, flow, and increased temperatures.	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with decommissioning and relocating roads, improving streams, wetlands, and riparian habitat.
Riparian Areas	DC 79	Riparian vegetation consists mostly of native species that support a wide range of vertebrate and invertebrate species and are free of invasive plant and animal species.	Habitat quality by decreased riparian vegetation complexity.	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with reducing catastrophic fire risk, decommissioning and relocating roads, improving streams, wetlands, and riparian habitat.
Riparian Areas	DC 80	Riparian obligate species within wet meadows, around springs and seeps, along streambanks, and active	Habitat quality by decreased riparian	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
		floodplains provide sufficient vegetative ground cover (herbaceous vegetation, litter, and woody riparian species) to protect and enrich soils, trap sediment, mitigate flood energy, stabilize streambanks, and provide for wildlife and plant needs.	vegetation complexity.	using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with decommissioning and relocating roads, improving streams, wetlands, spring, and riparian habitat.
Riparian Areas	DC 84	Floodplains and adjacent upland areas provide diverse habitat components (e.g., vegetation, debris, logs) as necessary for migration, hibernation, and brumation (extended inactivity) specific to the needs of riparian-obligate species (e.g., New Mexico meadow jumping mouse, Arizona montane vole, narrow-headed gartersnake).	Habitat quality by decreased riparian vegetation complexity.	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with decommissioning and relocating roads, improving streams, wetlands, and riparian habitat.
Riparian Areas	GL 29	Ground-disturbing projects (including prescribed fire) which may degrade long term riparian conditions should be avoided.	Habitat quality by decreased riparian vegetation complexity.	Project mitigations for primary stream shade zone (AQ035, AQ037-38, SI001, SI008, SI0012). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts (AQ008, AQ014, AQ025, AQ032-34, SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW070). Rock pit minimization measures (SW103, SW105, SW108, SW110-112) and fireline criteria (FE008, SW013, SW074-75). AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017). Impacts with grazing post-project (RM004, SW017). Yarding mitigations (SW048-53).
Riparian Areas	GL 30	Wet meadows, springs, seeps and cienegas should not be used for concentrated activities (e.g., equipment storage, forest product or mineral stockpiling, livestock handling facilities, special uses) that cause damage to soil and vegetation.	Habitat quality by increasing contaminants and sediment	AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017).
Riparian Areas	GL 32	Storage of fuels and other toxicants should be located at least 100 feet outside of riparian areas to prevent spills that could impair water quality or harm aquatic species.	Habitat quality by increasing contaminants	Project mitigations for staging areas away from water, refueling and servicing areas away from water, SWPP plans, checking equipment for leaks, and not allowing

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
				contaminants from entering water bodies (AQ026, SW011, SW020-023).
Riparian Areas	GL 33	Equipment should be fueled or serviced at least 100 feet outside of riparian areas to prevent spills that could impair water quality or harm aquatic species.	Habitat quality by increasing contaminants and sediment	Project mitigations for staging areas away from water, refueling and servicing areas away from water, SWPP plans, checking equipment for leaks, and not allowing contaminants from entering water bodies (AQ036, SW011, SW020-023).
Invasive Species	ST 11	Projects and authorized activities shall be designed to reduce the potential for introduction of new species or spread of existing invasive or undesirable aquatic or terrestrial nonnative populations.	Habitat quality by increased risk of introduction/spread of aquatic invasive species or disease.	Conservation measures for decontamination of equipment, materials, and personnel entering any water body (AQ001, AQ031), transferring water between water bodies (AQ0026),
Invasive Species	GL 76	Projects and activities should not transfer water between drainages or between unconnected water bodies within the same drainage to avoid spreading disease and aquatic invasive species.	Habitat quality by increased risk of introduction/spread of aquatic invasive species or disease.	Conservation measures transferring water between water bodies (AQ0026).
Invasive Species	GL 77	Project areas should be monitored to ensure there is no introduction or spread of invasive species.	Habitat quality by increased risk of introduction/spread of aquatic invasive species or disease.	Covered in the implementation and monitoring plan
Motorized Opportunities	GL 98	As projects occur in riparian or wet meadow areas, unneeded roads or motorized trails should be closed or relocated, drainage restored, and native vegetation reestablished to move these areas toward their desired condition.	Habitat quality by increased sedimentation	Proposed activities include road relocation and decommissioning. Project mitigations for roads (SW086, TR001, TR013).
Motorized Opportunities	GL 100	As projects occur, redundant roads or motorized trails should be removed to reduce degradation of natural resources.	Habitat quality by increased sedimentation and road density	Proposed activities include road relocation and decommissioning. Project mitigations for roads (SW086, TR011, TR013).

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Motorized Opportunities	GL 101	Roads and motorized trails removed from the transportation network should be treated in order to avoid future risk to hydrologic function and aquatic habitat.	Habitat quality by increased sedimentation	Proposed activities include road relocation and decommissioning. Project mitigations for roads (SW086, TR011, TR013).
Natural Landscape	GL 195	Temporary road construction and motorized equipment may be used in order to achieve ecological desired conditions.	Habitat quality by increased sedimentation and road density	Proposed activities include use of temporary roads. Project mitigations apply limitations (AQ006, AQ015, SW010, SW043, SW083, TR001-3, TR010).
TONTO NF				
Fire Management	S&G (management areas 1F, 4D, 4F):	Use prescribed fire to treat vegetation for water yield, forage, and wildlife habitat improvement	Habitat quality	Proposed activities include prescribed fire treatments. Project mitigations for roads are included in the alternatives.
Forestry and Forest Health	S&G (management area 4D, 5D):	Timber sale road systems should be designed to minimize impacts on stream channels and water quality. Roads should be located on slopes less than 60%, and should have sustained gradients of less than 8%. Roads should not be located on unstable slopes where mass movement is likely to occur.	Habitat quality by increased sedimentation.	Negative short-term impacts from timber sale road systems including opening ML-1 roads and utilizing temporary roads. Long term benefits of road relocation and decommissioning. Project mitigations for roads are included in the alternatives. Minimizing temporary road impacts (AQ006, AQ015, SW010, SW043, SW083, TR001-3, TR010). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW070).
Forestry and Forest Health	S&G (management area 4D)	An Interdisciplinary (I.D.) team will evaluate the need for buffer strips adjacent to water bodies within proposed commercial saw timber sale areas. Where a buffer strip is deemed necessary, the I.D. team will recommend the width of strip needed to achieve adequate protection of aquatic and riparian resources. The width of the buffer strip will depend upon such factors as channel stability, side-slope steepness, erodibility of soils, existing ground cover conditions, and existing aquatic conditions. Logging vehicles will not be allowed to operate within any such designated buffer strips, except at designated crossings.	Habitat quality by increasing sedimentation and decreasing canopy cover.	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with decommissioning and relocating roads, improving streams, wetlands, spring, and riparian habitat. Project includes general AMZs and species specific AMZs to maintain water quality and suitable stream temperatures. AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017). Project mitigations for protecting the riparian shade zone during mechanical vegetation treatments (AQ035, AQ037-38, SI001, SI008, SI0012) and limiting high burn severity and areal

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				(canopy) mortality from prescribed burning (FE003, FE007, SW014).
Forestry and Forest Health	S&G (management area 4D, 5D):	Slash and debris should be kept out of protected stream channels.	Habitat quality by increasing sedimentation	Project mitigation to minimize amount of thinning debris deposited in stream channels and remove excess debris (SW007)
Wildlife, Fish, and Rare Plants	S&G:	Identify, survey, map, and analyze habitat for all Federally-listed species. Identify management conflicts and enhancement opportunities. Correct any management conflicts or problems.	Minimizing negative species impacts.	Species distribution maps were created and used for effects analysis for all aquatic species. Project specific conservation measures, design features and BMPs are included as part of the proposed action to minimize conflicts and negative impacts.
Wildlife, Fish, and Rare Plants	S&G:	Continue to clear all projects for threatened, endangered, proposed, and candidate plant and animal species. Clearances will be done by Wildlife Biologist and reviewed by Forest Biologist.	Minimizing negative species impacts.	Proposed alternatives were analyzed for effects to all aquatic species. Project specific conservation measures, design features and BMPs are included as part of the proposed action to minimize conflicts and negative impacts.
Wildlife, Fish, and Rare Plants	S&G:	Initiate informal or formal consultation, as required by the ESA, with the USFWS on all actions that effect T&E plant and animal species	Minimizing negative species impacts.	Informal and formal consultation will be completed as part of the proposed project prior to signing the Record of Decision.
Wildlife, Fish, and Rare Plants	S&G:	New additions of listed, proposed or candidate species by the US Fish and Wildlife Service will be protected.	Minimizing negative species impacts.	Proposed alternatives were analyzed for effects to all aquatic species. Project specific conservation measures, design features and BMPs are included as part of the proposed action to minimize conflicts and negative impacts.
Wildlife, Fish, and Rare Plants	S&G:	Habitat requirements for endangered species will have precedence over threatened species.	Minimizing negative impacts to listed species.	Project mitigations for FS, AZGFD, and USFWS to cooperatively determine timing restrictions where species overlap. Federally listed species have conservations measures included as part of project design.
Wildlife, Fish, and Rare Plants	S&G:	In streams inhabited by fish, structures need to provide for fish passage. In addition, structures containing natural stream bottoms are preferred over culverts.	Habitat quality by decreasing connectivity	Negative short-term impacts associated with opening and using ML1 roads and temp roads. Long-term benefits associated with decommissioning and relocating roads, improving stream crossings, and providing for fish passage in headcut structures.

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Wildlife, Fish, and Rare Plants	S&G:	Avoid channel changes or disturbance of stream channels and minimize impacts to riparian vegetation.	Habitat quality by increasing sedimentation	Negative short-impacts through stream restoration activities. Long-term beneficial impacts of increased channel sinuousity, complexity, and streambank stability. Project mitigations for primary stream shade zone (AQ035, AQ037-38, SI001, SI008, SI0012). Stream restoration measures to reduce impacts (AQ008, AQ014, AQ025, AQ032-34, SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99).
Wildlife, Fish, and Rare Plants	S&G (1996 amendments):	Monitoring and evaluation should be collaboratively planned and coordinated with involvement from each national forest, USFWS Ecological Services Field Office, USFWS Regional Office, USDA Forest Service Regional Office, Rocky Mountain Research Station, recovery team, and recovery unit working groups.		Implementation and monitoring plan
	S&G (1996 amendments):	When activities conducted in conformance with these standards and guidelines may adversely affect other threatened, endangered, or sensitive species or may conflict with other established recovery plans or conservation agreements; consult with the USFWS to resolve the conflict.	Minimizing negative species impacts.	Informal and formal consultation will be completed as part of the proposed project prior to signing the Record of Decision.
COCONINO NF				
Watersheds and Water	DC:	Watersheds exhibit high geomorphic, hydrologic, and biotic integrity within their inherent capability. Natural hydrologic, hydraulic, geomorphic, and biologic processes function at a level that allows retention of their unique physical and biological properties to maintain or improve downstream water quality.	Habitat quality by increasing sedimentation and decreasing canopy cover.	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Watersheds and Water	DC:	Watersheds exhibit a high degree of connectivity along streams, laterally across floodplains and valley bottoms and vertically between surface and subsurface flows. Streamcourses and other links between aquatic and upland components provide access to food, water, cover, nesting areas, and protected pathways for aquatic and upland species.	Habitat quality by increasing sedimentation and decreasing canopy cover.	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.

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Watersheds and Water	DC:	Water quality, water quantity and the timing of water flows support ecological functions, habitat for aquatic and riparian species, and water sources for municipalities. Water quality, water quantity, and the timing of flows are sustained at levels that retain the biological, physical, and chemical integrity of associated systems and benefit survival, growth, reproduction, and migration of native species.	Habitat quality by increasing contaminants and sediment	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Watersheds and Water	GL:	Best management practices for management activities should be identified, implemented, and monitored to maintain water quality, quantity, and timing of flows, and to prevent or reduce accelerated erosion.	Habitat quality by increasing contaminants and sediment	Project mitigations for timing, slope, and spatial extent of ground disturbing activities allowed (AQ014, AQ032, AQ033, FE008, FE013, RM004, SW001-2, SW004-7, SW012-14, SW017-18, SW027, SW032, SW033, SW034, SW041, SW044, SW045, SW046, SW048, SW049, SW050, SW051, SW052, SW053, SW054-58, SW060, SW063-64, SW066-69, SW071-72, SW074-80, SW093, SW100, TR014). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts (AQ008, AQ014, AQ025, AQ032-34, SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW070). Rock pit minimization measures (SW103, SW105, SW108, SW110-112and fireline criteria (FE008, SW013, SW074-75).
Constructed Waters	GL:	For new projects and management activities, a site-specific aquatic management zone should be identified and maintained around reservoirs to protect water quality and to avoid detrimental changes in water temperature or chemical composition, blockages of streamcourses, or sediment deposits that would seriously and adversely affect water conditions or aquatic habitat. Soil and vegetation disturbance from management activities should be minimized to meet this intent, but is not necessarily excluded in this zone.	Habitat quality by increasing sedimentation, decreasing canopy cover.	AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017).

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All Riparian Areas	DC:	Riparian areas exhibit connectivity between and within aquatic, riparian and upland components that reflects their natural range of variability and linkages. Naturally isolated springs remain isolated. Riparian areas are connected vertically between surface and subsurface flows. Streamcourses and other links between aquatic and upland components support ecological functions, and provide habitat and movement corridors for aquatic and upland species.		Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
All Riparian Areas	GL:	Management activities such as vegetation treatments or other restoration actions should be designed to maintain or move toward desired conditions for other uses and resources.		Project mitigations for primary stream shade zone (AQ035, AQ037-38, SI001, SI008, SI0012). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts (SW032-047, SW054, SW057, SW060, SW070). Rock pit minimization measures (SW103, SW105, SW108, SW110-112) and fireline criteria (FE008, SW013, SW074-75). AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017). Impacts with grazing post-project (RM004, SW017). Yarding mitigations (SW048-53).
All Riparian Areas	GL:	Riparian areas should be managed to promote natural movement of water and sediment, to maintain ecological functions, and to maintain habitat and corridors for species.	Habitat quality by increasing sedimentation and decreasing canopy cover.	Project mitigations for primary stream shade zone (AQ035, AQ037-38, SI001, SI008, SI0012). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts ((AQ008, AQ014, AQ025, AQ032-34, SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW070). Rock pit minimization measures (SW103, SW105, SW108, SW110-112)) and fireline criteria (FE008, SW013, SW074-75). AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017). Impacts with grazing post-

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
				project (RM004, SW017). Yarding mitigations (SW048-53
All Riparian Areas	GL:	An aquatic management zone should be identified and maintained in riparian areas to protect water quality and to avoid detrimental changes in water temperature or chemical composition, blockages of stream courses, or sediment deposits that would seriously and adversely affect water conditions, fish habitat, or connected downstream cave, karst, and lava tube resources. Soil and vegetation disturbance from management activities should be managed to meet these intents, but is not necessarily excluded in this zone.	Habitat quality by increasing contaminants and sediment	AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017).
Stream Ecosystems	GL:	An aquatic management zone for non-riparian, intermittent stream courses should be identified and maintained to reduce sedimentation, maintain functioning of the channel within its floodplain, and maintain downstream water quality and riparian habitat and function. This management zone would also avoid detrimental changes in water temperature or chemical composition; blockages of stream courses; or sediment deposits that would seriously and adversely affect water conditions, fish habitat, or connected downstream cave, karst, and lava tube resources. Soil and vegetation disturbance from management activities should be managed to meet these intents, but is not necessarily excluded in this zone. The general starting points for widths of aquatic management zones are shown in table 2	Habitat quality by increasing contaminants and sediment	AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017).
Springs	DC:	The physical and biological components of springs provide habitat for narrowly endemic species and those with restricted distributions.		Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temp roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Springs	GL:	Projects and activities should be designed and implemented to maintain or improve soil and riparian		Species conservation measures to minimize impacts (AQ018-025, FE006, FE0). Project mitigations for

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		function; maintain or improve native vegetation; and/or prevent the introduction or spread of disease, invasive, or undesirable species. Design features could include road, recreation, and/or livestock management.		decontamination of equipment and personnel entering any water body (AQ001, AQ031), transferring water between water bodies (AQ0026), and preventing contaminants from entering aquatic habitats (AQ026, SW011, SW020-23). Project mitigations for primary stream shade zone (AQ035, AQ037-38, SI001, SI008, SI0012). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts (AQ008, AQ014, AQ025, AQ032-34, SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW070). AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017).
Riparian Forest Types	GL	In riparian forests, recreation activities, permitted uses, and management activities should occur at levels that maintain or allow improvement of soil function, riparian vegetation, and water quality at the stream reach scale. This guideline would not apply to fine-scale activities and facilities such as intermittent livestock crossing locations, water gaps, or other infrastructure used to manage impacts to riparian areas at a larger scale.	Habitat quality by increase sedimentation and decreasing canopy cover	Project mitigations for primary stream shade zone (AQ035, AQ037-38, SI001, SI008, SI0012). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts (AQ008, AQ014, AQ025, AQ032-34, SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW070). Rock pit minimization measures (SW103, SW105, SW108, SW110-112) and fireline criteria FE008, SW013, SW074-75). AMZs and associated guidance: (AQ021, DE007, SW001-2, SW004-9, SW012-017). Impacts with grazing post-project (RM004, SW017). Yarding mitigations (SW048-53).
Wildlife, Fish and Plants	DC:	Properly functioning ecosystems and ecologically responsible forest activities support sustainable populations of native plant and animal species distributed throughout their potential natural range.	Habitat quality by increase sedimentation and	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving

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		Properly functioning ecosystems reflect the diversity, quantity, quality, and site potential of natural habitats on the Forest. Habitat is available at the appropriate spatial, temporal, compositional, and structural levels for a wide variety of species.	decreasing canopy cover	towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Wildlife, Fish and Plants	DC:	Habitat conditions contribute to the survival and recovery of listed species, allow for repatriation of extirpated species, contribute to the delisting of species under the Endangered Species Act, preclude the need for listing new species, improve conditions for Southwestern Region sensitive species, and keep common native species common. Habitat conditions provide the resiliency and redundancy necessary to maintain species diversity and metapopulations.	Habitat quality by increase sedimentation and decreasing canopy cover	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Wildlife, Fish and Plants	DC:	Stream ecosystem conditions within perennial and intermittent riparian streamcourses support habitat for self-sustaining populations of native aquatic and riparian species. Woody and herbaceous overstory and understory (where the natural potential exists) and overhanging banks provide fish habitat, regulate stream temperatures, and maintain soil moisture in the aquatic management zone. Stream substrates provide clean gravels for fish spawning, woody debris for hiding cover, and sites for germination and establishment of riparian vegetation. Abiotic structure such as silt, sand, gravel, cobble, boulders, and bedrock provide habitat for a variety of aquatic and terrestrial species.	Habitat quality by increase sedimentation and decreasing canopy cover	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Wildlife, Fish and Plants	DC:	The composition, structure and function of ERUs and associated physical elements (such as canyons, cliffs, caves, karst, talus slopes, rock piles, specific soil types, springs, wet areas, and other special features) provide functioning habitat and refugia to support populations of federally listed, Southwestern Region sensitive species, narrowly endemic species, and species with restricted distributions.	Habitat quality	Negative short term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
Wildlife, Fish and Plants	DC:	Interconnected terrestrial, riparian, and aquatic habitats promote wildlife, fish, and plant species movements and genetic exchange, allow for movement of wide ranging species, and promote natural predator-prey relationships, particularly for strongly interactive species (such as mountain lions). Species are able to access adjoining habitat, disperse, migrate, meet their life history requirements, and adjust their movements in response to climate change. Ephemeral and intermittent streamcourses function as habitat and movement corridors for species.	Habitat quality by decreasing connectivity	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Wildlife, Fish and Plants	DC:	Species populations are supported by their natural habitats. When natural habitats are unable to support species populations, active management and human-made or altered habitats support populations and meet conservation objectives.	Habitat quality	Negative short-term impacts associated with mechanical vegetative treatments, prescribed burning, opening and using ML1 roads and temporary roads, and stream restoration. Long-term benefits associated with moving towards desired condition, decommissioning and relocating roads, improving stream, wetland, and riparian habitat.
Wildlife, Fish and Plants	DC:	Passage barriers are present in some streams when needed to physically separate native and non-native aquatic species.	Habitat quality by decreasing connectivity	Negative short-term impacts associated with mechanical vegetative treatments, opening and using ML1 roads and temporary roads. Long-term benefits associated with decommissioning and relocating roads, improving stream crossings, and providing for fish passage in headcut structures.
Wildlife, Fish and Plants	ST:	Direction for species listed as threatened, endangered, proposed, or candidate takes precedence over direction for species not listed by the U.S. Fish and Wildlife Service.	Minimizing negative species impacts.	Direction for federally listed species does take precedence over non-listed species. Species conservation measures where written to minimize impacts to aquatic federally listed species (AQ018-025, FE006, FE009).
Wildlife, Fish and Plants	GL:	Habitat management objectives and species protection measures from approved recovery plans should be applied to activities occurring within federally listed species habitat to promote recovery of the species.	Minimizing negative species impacts.	Habitat management objectives and conservation measures came from recovery plans, recovery strategies, and guidance from USFWS species leads. Species conservation measures to minimize impacts to federally listed species (AQ018-025, FE006, FE009).
Wildlife, Fish and Plants	GL:	To improve the status of species and prevent Federal listing, management activities should comply with	Minimizing negative species impacts.	Habitat management objectives and conservation measures came from recovery plans, recovery strategies, and guidance from USFWS species leads Species

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		species conservation agreements, assessments, strategies, or national guidelines.		conservation measures to minimize impacts to federally listed species (AQ018-025, FE006, FE009).
Wildlife, Fish and Plants	GL:	Projects and management activities should be designed or managed to maintain or improve habitat for native species and to prevent or reduce the likelihood of introduction or spread of disease.	Minimizing negative species impacts.	Conservation measures for decontamination of equipment and personnel entering any water body (AQ001, AQ031), transferring water between water bodies (AQ0026).
Wildlife, Fish and Plants	GL:	Timing restrictions should be applied to projects and activities that potentially negatively affect Southwestern Region sensitive species and pronghorn. The intent is to minimize or avoid impacts to survival or successful reproduction.	Minimizing negative species impacts.	Project mitigations for timing, slope, and spatial extent of ground disturbing activities allowed (AQ014, AQ032, AQ033, FE008, FE013, RM004, SW001-2, SW004-7, SW012-14, SW017-18, SW027, SW032, SW033, SW034, SW041, SW044, SW045, SW046, SW048, SW049, SW050, SW051, SW052, SW053, SW054-58, SW060, SW063-64, SW066-69, SW071-72, SW074-80, SW093, SW100, TR014). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts (AQ008, AQ014, AQ025, AQ032-34, SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW070). Rock pit minimization measures (SW103, SW105, SW108, SW110-112) and fireline criteria (FE008, SW013, SW074-75).
Wildlife, Fish and Plants	GL:	Projects and management activities should be designed and implemented to maintain refugia and primary life cycle needs of Southwestern Region sensitive species and to protect and provide for narrowly endemic species and species with restricted distributions where they are likely to occur.	Minimizing negative species impacts.	Project mitigations for timing, slope, and spatial extent of ground disturbing activities allowed (AQ014, AQ032, AQ033, FE008, FE013, RM004, SW001-2, SW004-7, SW012-14, SW017-18, SW027, SW032, SW033, SW034, SW041, SW044, SW045, SW046, SW048, SW049, SW050, SW051, SW052, SW053, SW054-58, SW060, SW063-64, SW066-69, SW071-72, SW074-80, SW093, SW100, TR014). Minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14). Stream restoration measures to reduce impacts (AQ008, AQ014, AQ025, AQ032-34,

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
				SI001, SI003, SI012, SI023, SW008, SW026-28, SW063, SW081-82, SW087-88, SW096-99). Skid trail restrictions (SW032-047, SW054, SW057, SW060, SW070). Rock pit minimization measures (SW103, SW105, SW108, SW110-112) and fireline criteria (FE008, SW013, SW074-75).
Wildlife, Fish and Plants	GL:	Established protocols should be followed to prevent the introduction and spread of disease, such as chytrid fungus (*Batrachochytrium dendrobatidis*) that kills amphibians.	Habitat quality by reducing stream flow, increased risk of introduction/spread of aquatic invasive species or disease.	Conservation measures for decontamination of equipment and personnel entering any water body (AQ001, AQ031), transferring water between water bodies (AQ0026).
Invasive Species	GL:	Measures should be incorporated into authorized activities, project planning, and implementation to prevent, control, contain, and eradicate priority infestations or populations of invasive species to ensure the integrity of native species populations and their habitats is maintained.	Habitat quality by increased risk of introduction/spread of aquatic invasive species or disease.	Conservation measures for decontamination of equipment and personnel entering any water body (AQ001, AQ031), transferring water between water bodies (AQ0026).
Fire management	GL:	Fire management activities should be designed to be consistent with maintaining or moving toward desired conditions for other resources.	Habitat quality by increased sedimentation and decrease canopy cover.	Proposed activities are designed to maintain or move towards desired conditions across the project area. Project guidance and mitigations include creating mosaics (FE003, FE007-8, FE013, SW012-14, SW079-80).
Roads and Facilities	DC:	Temporary increases in roads are appropriate for projects associated with watershed protection and restoration. Temporary roads that support ecosystem restoration activities, fuels management, or other short-term projects are rehabilitated promptly after project completion.	Habitat quality by increased sedimentation	Negative short-term impact from timber sale road systems, opening ML1 roads, and use of temporary roads. Long-term benefits from decommissioning roads.
Roads and Facilities	GL:	Roads should be located, designed, and maintained to move toward or maintain desired conditions for other uses and resources.	Habitat quality by decreasing connectivity	New system road construction is not included in proposed activities; decommissioning and relocating roads is proposed. Design features minimizing temporary, road relocation, and road decommissioning impacts (AQ006,

Plan Section	Component Number	Desired Condition (DC), Objective (OBJ), Standard (ST), and Guideline (GL) [footnote]	Primary Project Impacts	How/Why project is compliant with Forest Plan component.
				AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14).
Roads and Facilities	GL:	Existing roads should be used or realigned before new roads are constructed to avoid areas where disturbance-sensitive threatened and endangered species are present.	Habitat quality by decreasing connectivity	New system road construction is not included in proposed activities; decommissioning and relocating roads is proposed. Design features minimizing temporary, road relocation, and road decommissioning impacts (AQ006, AQ015, SW010, SW043, SW083, SW086, TR001-3, TR010, TR011-14).
Roads and Facilities	GL:	For projects where long-term access is not needed, temporary roads should be used and naturalized in a timely manner. The intention is to have the road footprint, and potential impacts from road use, such as possible introduction of invasive species, modification of scenic integrity objectives, or increased sedimentation into connected waters, on the landscape for as short a time as possible.	Habitat quality by decreasing connectivity	Project activities include temporary roads and does not include new system road construction.
Roads and Facilities	GL:	Bridges, culverts, stream crossings on permanent roads, and diversion structures should be designed to allow safe passage for aquatic organisms. Passage barriers are acceptable when needed to physically separate native and non-native species.	Habitat quality by decreasing connectivity	Proposed activities include maintaining or improving stream crossings as necessary to implement the project. Guidance for maintaining or improving aquatic passage is also included.
Trails and Trailheads	GL:	Unplanned, user-created trails should be managed to prevent future access. Resources damaged by unplanned, user-created trails should be rehabilitated to accelerate recovery and to prevent further resource impacts.	Habitat quality by increasing sediment and road density	Proposed activities include stabilizing and restoring unauthorized roads to a more natural state.