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Las Cienegas Landscape Restoration Final Environmental Assessment

BLM

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List of Acronyms

ADEQ	Arizona Department of Environmental Quality
ATV	all-terrain vehicle
BLM	US Department of the Interior Bureau of Land Management
BMP	best management practice
BOR	U.S. Bureau of Reclamation
CFR	Code of Federal Regulations
CWP	Cienega Watershed Partnership
DNA	determination of NEPA adequacy
EA	environmental assessment
EDRR	early detection and rapid response
ESA	Endangered Species Act
LCNCA	Las Cienegas National Conservation Area
MLRA	Major Land Resource Area
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
PEIS	programmatic environmental impact statement
RMP	resource management plan
SVAPD	Sonoita Valley Acquisition Planning District
TFO	BLM Tucson Field Office
USDA	US Department of Agriculture
UTV	utility terrain vehicle

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1 INTRODUCTION

1.1 Background

In accordance with National Environmental Policy Act (NEPA) implementing procedures (10 Code of Federal Regulations [CFR] 1021), the Bureau of Land Management (BLM) Tucson Field Office (TFO) has prepared the Las Cienegas Landscape Restoration Environmental Assessment (EA) to evaluate impacts associated with proposed erosion control and vegetation treatments on public, private, county, and state lands within a 216,732-acre project area. This area lies 50 miles southeast of the city of Tucson, Arizona. Within the project area, land ownership is a combination of BLM, State, county, and private land (Table 1). The project area includes the BLM's 46,000-acre Las Cienegas National Conservation Area (NCA), Arizona State Trust Land, the Sonoita Valley Acquisition Planning District (SVAPD), and Pima County's Cienega Creek Natural Preserve and J-6, Bar V, Clyne, and Sand's Ranches as well as the Appleton-Whittell Research Ranch Sanctuary and several private ranches (Figure 1).

Table 1. Land Ownership in the Las Cienegas Landscape Restoration EA Planning Area

Land Ownership	Project Area (acres)
BLM	51,301
State	96,444
Pima County	10,391
Private	58,596
Total	**216,732**

Past land management practices coupled with long term drought have affected the character and composition of vegetation communities in southeastern Arizona (Bahre 1991). This change in the project area has occurred as an increase in woody plant species cover resulting in a decrease in perennial grass cover, with a potential for increases in soil erosion (BLM 2003, Gori and Schussman 2005).

The Cienega watershed area has a long history of public engagement and collaborative adaptive management. Partners have worked together in this area since the late 1980s when residents advocated for private lands within the Cienega watershed to be brought into BLM ownership. These lands, originally called the Empire-Cienega Resource Conservation Area, were designated as the Las Cienegas NCA in 2000. The BLM and stakeholders have used shared goals and measurable objectives in this area to implement collaborative adaptive management. Facilitated by BLM, partners come together to collect data, evaluate, and provide recommendations to the BLM on resource management.

This collaborative adaptive management approach has been used to implement vegetation treatments to restore grassland habitat and to curtail soil erosion through grant-funded erosion control workshops. Previously, the BLM completed vegetation treatments on approximately 19,401 acres using prescribed fire, chemical, and mechanical methods in the Las Cienegas NCA. Erosion control and stream restoration projects have been constructed in Los Pozos Gulch and on Cienega Creek near the agricultural fields and its confluence with Springwater Canyon (see Table 2 and Figure 2). Monitoring from these treatments has indicated that the most effective techniques in reducing woody plant cover are mechanical and cut spray with herbicide (Tiller et al. 2012a). Restored cienega wetlands have been treated to control invasive plants such as bulrush, cattail, and sapling riparian trees at four locations (Figure 2). This EA will assess a broad array of landscape restoration methods available to be applied on a landscape scale across jurisdictions both within and surrounding the BLM's LCNCA to expand the habitat restoration efforts. This EA will also assess methods for maintaining the existing treatment areas, implementing future treatments, implementing site-specific erosion control projects, and evaluating erosion control and stream restoration in the treatment areas and in designated sites (Appendix C, Figure 2). Currently, four site-specific erosion control projects are proposed to occur that would be funded by a grant from the Arizona Department of Environmental Quality (ADEQ).

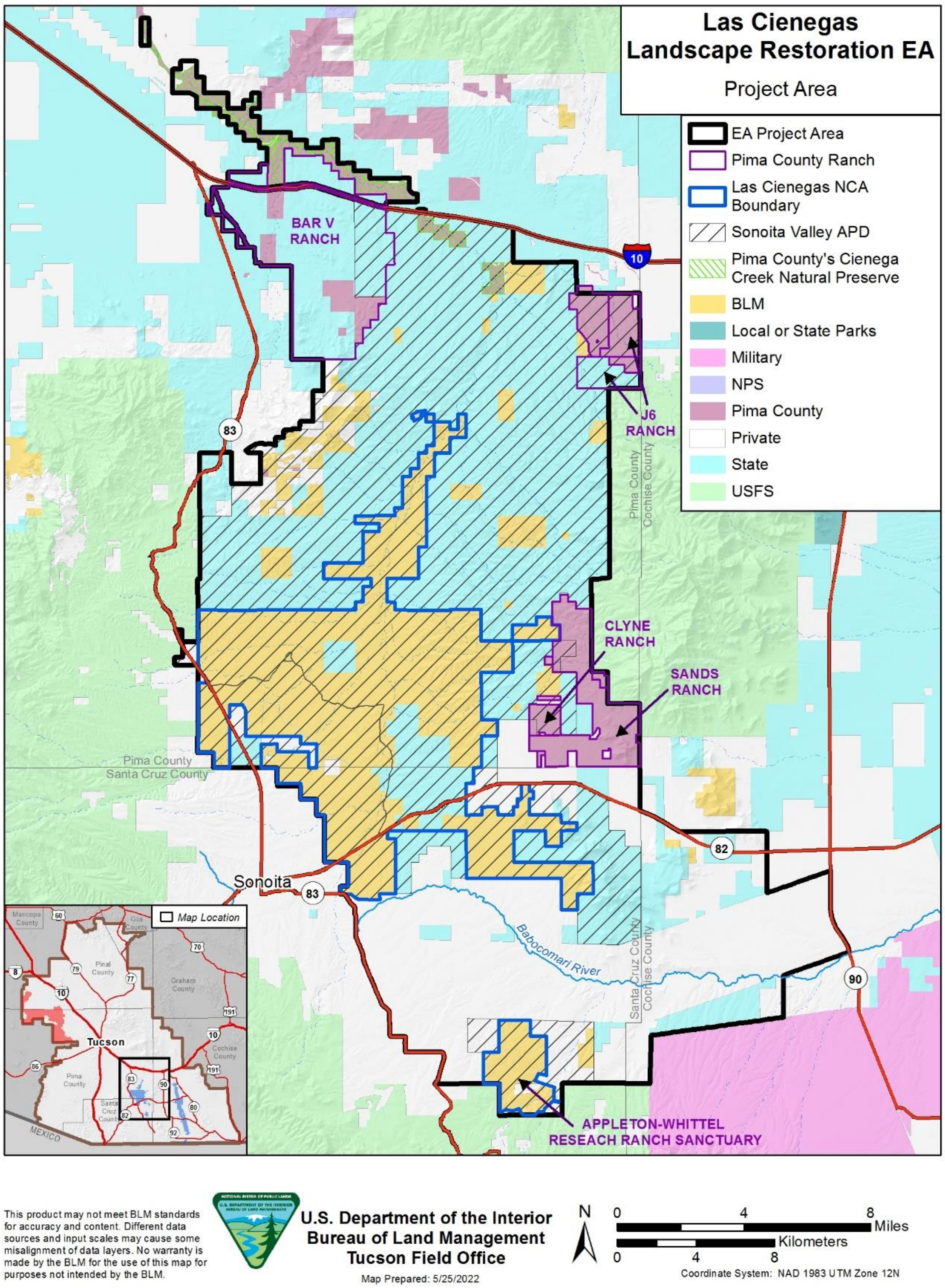

Figure 1. Landscape Restoration EA Project Area

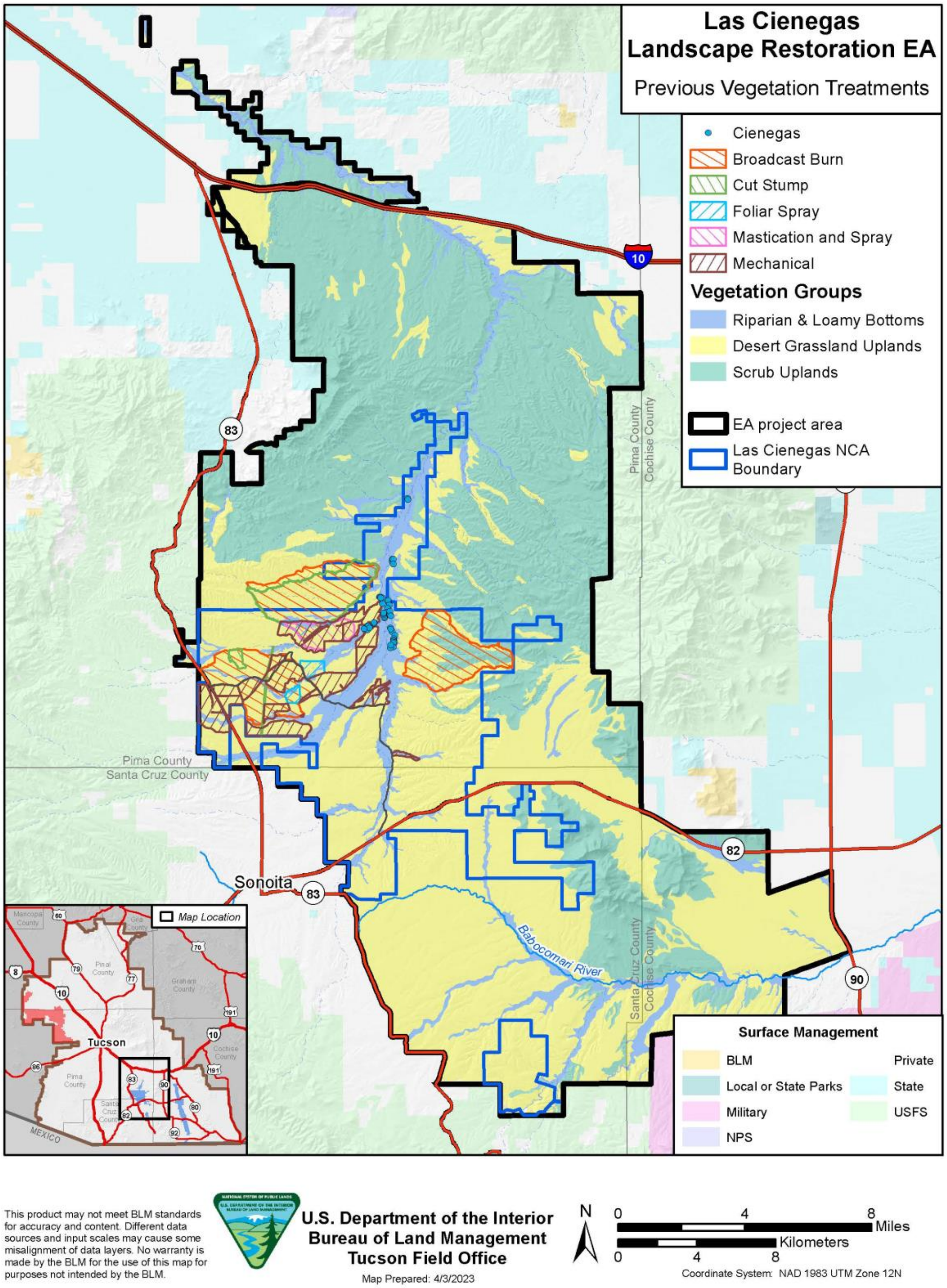

Figure 2. Landscape Restoration EA Previous Vegetation Treatments (2007-2022)

Table 2. Summary of Vegetation Treatments Conducted on Las Cienegas NCA (2007-2022)

Vegetation Treatment Type	Acres
Prescribed fire	9,827
Chemical treatment	1,615
Mechanical treatment	7,959
Total	**19,401**

1.2 Purpose of and Need for Action

The purpose of this project is to expand the area and methods used to treat and maintain tree- and shrub-invaded upland areas, maintain sacaton grasslands, mesquite bosques, wetlands, and riparian areas, and treat areas invaded with noxious species so that those areas meet the vegetation and watershed objectives described in the Las Cienegas Resource Management Plan (RMP) and listed in Appendix A. The purpose of this project also includes treating existing and future potential soil erosion areas with erosion control structures to mitigate and/or prevent erosion. The project is at the landscape scale to promote ecosystem processes and habitat diversity that support desired future conditions for fish and wildlife, including federally listed species.

The need for the proposed action is based on data showing that vegetation communities are departed from desired future conditions (Table 3 below) as described in the Las Cienegas RMP resource objectives and resource objectives for the surrounding areas and the documentation of areas of accelerated upland and stream channel erosion (BLM 2003).

To assess the on-the-ground conditions of the project area and to estimate areas of similar types of treatments, ecological sites have been broadly grouped into five vegetation types to facilitate vegetation management: 1) desert grassland uplands; 2) scrub uplands; 3) loamy bottoms; 4) riparian; and 5) cienegas. (Table E-1, Appendix E). An ecological site is an area of land whose dominant soil characteristics, landscape location, and rainfall conditions are uniquely grouped together. The Natural Resources Conservation Service (NRCS) has derived ecological sites to describe the potential vegetation. A full description of each ecological site is available on the NRCS website (NRCS 2019).

Multiple data sources were used to assess the current vegetation cover and the difference from the Las Cienegas RMP (2003) objectives for shrub or tree cover. Since the RMP objectives are based on expected ecological site conditions and returning to those conditions where possible, they are stepped down for certain sites based on appropriate levels of shrub or tree cover found in the ecological site description. In several instances, the RMP already specified a total tree cover maximum (e.g. desert grasslands) thus that value was used.

Table 3. Vegetation communities and departure estimates for tree and shrub cover

Vegetation Community	Description (e.g. ecological site names)	Data Sources	Tree/Shrub Objective	Acres Not Meeting Objective	Total Acres	Percent Not Meeting Objective
Scrub Uplands	Granitic Hills, Granitic Upland, Limestone Hills, Limy Slopes, Volcanic Hills	NRCS Ecological Sites	*<10% total tree cover AND <15% total shrub cover*	68,918	93,667	74%
Desert Grassland Uplands	Loamy Slopes, Loamy Swale, Loamy Upland, Sandy Loam Uplands, Clayey Swales,	NRCS Ecological Sites	*<5% total tree cover AND <15% total shrub cover*	36,425	104,894	35%

Vegetation Community	Description (e.g. ecological site names)	Data Sources	Tree/Shrub Objective	Acres Not Meeting Objective	Total Acres	Percent Not Meeting Objective
	Clayey Uplands, Basalt Hills, Clay Loam Upland					
Riparian	Sandy Wash	NRCS Ecological Sites USFS R3 Riparian		--	1,457	--
Mesquite Bosque (grouped into loamy bottoms)	Loamy Bottoms	NRCS Ecological Sites, Tiller et al. 2012b, USGS 2019	*Maintain cover of 25-65% cover. Tree density of 200-500 trees per hectare*	10,560	16,397	64%
Sacaton Grasslands (grouped into loamy bottoms)		NRCS Ecological Sites, Tiller et al. 2012b, USGS 2019	*<10% total tree cover*			
Cienegas	Southwest Interior Marshland located in Loamy Bottoms, Sandy Wash	BLM, DBG 2016		12	317	4%

Desert Grassland & Scrub Uplands

To estimate the total acreage of treatments that would potentially be completed in the planning area, a broadscale GIS-based vegetation departure analysis was conducted to give a coarse idea of the status of treatable acres. LANDFIRE (2019) data for Existing Vegetation Communities (EVC) was chosen as the best available dataset that covered the spatial extent of the project area. LANDFIRE has been used in similar applications across the United States (see https://www.landfire.gov/lf_applications.php). The LANDFIRE data has a 30-meter spatial resolution and indicates tree or shrub cover percentage at every pixel. The benchmarks for these two groups were derived from the Las Cienegas RMP objectives, which were determined to be greater than 5% tree or shrub cover for desert grasslands, and greater than 15% tree or shrub cover for scrub uplands (see Appendix A). These benchmarks when compared to the shrub and tree cover in the remote sensing data indicated that 35% of grassland sites and 74% of shrubland sites were departed from the shrub/tree cover objectives of the RMP.

In the desert grassland and scrub uplands vegetation communities when shrub cover crosses the 35% threshold, the site is now in a shrubland state where restoration may be impractical (Gori and Enquist 2003). According to the LANDFIRE data, approximately 11% of the desert grasslands and 20% of the scrub uplands have crossed this 35% threshold and transitioned into the shrubland state.

Loamy Bottoms (Mesquite Bosque & Sacaton Grasslands)

The loamy bottom ecological site departure was identified using site-specific assessments because this site has two different site potentials (mesquite bosque and sacaton grasslands) and thus two different possible sets of objectives to consider when identifying departure. This is best shown in the modified state and transition model developed by Tiller et al. (2012b, see Figure E-1 in Appendix E). The difference between these two potentials is dependent on the local hydrologic properties of the individual site. A depth to water of less than 20 feet, as well as some degree of flooding, is required to reach the sacaton grassland potential. If a site's hydrologic conditions have changed such that it no longer has the ability to reach its original potential, then a change in vegetation may be classified as departure when in reality the site is transitioning to the new potential. Considering this, estimates on loamy bottom treatment acreages is based on site-specific investigations (see Tiller et al. 2012b & Norman et al. 2019) that covered a combined 4,940 acres, which represent 30% of the sites in the project area. These results were extrapolated to the rest of the planning area. It is important to note that the sites identified in the field investigations were chosen for their high potential for the grassland state. Other parts of the project area (specifically below 4,300 feet elevation) may have a forestland, or bosque, site potential that makes up a greater proportion of the loamy bottom sites. Applying the percentages from the Tiller (2012) study to the rest of the project area would then likely overestimate the number of treatment acres (for sacaton grasslands) that would occur in the project area.

The objective in the RMP for loamy bottoms concerning habitat for breeding grasshopper sparrow and wintering Baird's sparrow establishes that two thirds of loamy bottom sites have less than 10% shrub cover (see Appendix A). When the RMP was written, this two-thirds proportion was determined to be the potential for these loamy bottom sites. Considering this and the lack of data to represent the hydrologic factors, we concluded that the remaining highly departed grasslands (C1 & C2 from the modified state and transition model) would be split such that a percentage of them would be considered to have a grassland potential and the remainder would have the forestland potential. This difference was determined by adding the lesser departed grassland acreages and determining the required acres to bring those sites up to two thirds, or 66.7%. This in turn meant that 36% of the highly departed sacaton grasslands (C1 & C2) have the site potential of the grassland state and the remainder of the sites have the potential for a forestland state.

Riparian Areas and Cienegas

For riparian areas and cienegas, the departure has not been identified and treatments in this EA would be based on site-specific knowledge.

1.3 Decision to Be Made

Based on the analysis contained in this EA, the BLM will determine whether to implement the proposed erosion control and vegetation treatments, prepare an EIS, or take no action.

1.4 Conformance with Applicable Land Use Plans

1.4.1 Safford District Resource Management Plan and Environmental Impact Statement, 1991

The proposed action (see Section 2) is in conformance with the Safford District Resource Management Plan and Final Environmental Impact Statement, approved in 1991, as amended (BLM 1991a). The BLM reviewed the proposed action to determine if it conforms to terms and conditions of the land use plan required by 43 CFR 1610.5 and BLM MS 1617.3.

1.4.2 Phoenix Resource Management Plan and Final Environmental Impact Statement, 1988

The proposed action is in conformance with the Phoenix Resource Management Plan and Final Environmental Impact Statement, approved in 1988, as amended (BLM 1988). The BLM reviewed the proposed action to determine if it conforms to the land use plan terms and conditions required by 43 CFR 1610.5, BLM MS 1617.3.

1.4.3 Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Record of Decision, 2004

The proposed action is in conformance with the Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Record of Decision, approved in 2004, to determine if the proposed action conforms to the land use plan goals and objectives required by 43 CFR 1610.5 and the BLM NEPA Handbook (H-1790-1).

1.4.4 Las Cienegas Resource Management Plan and Record of Decision, 2003

The proposed action is in conformance with the Las Cienegas RMP and Record of Decision, approved in 2004, to determine if the proposed action conforms to the land use plan goals and objectives required by 43 CFR 1610.5 and the BLM NEPA Handbook (H-1790-1). See Appendix A for a complete list of resource objectives.

1.5 Relationship to Statutes, Regulations, and Other Plans

In this EA, the BLM has responded to Secretarial Order 3362 on Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors. The proposed action would improve habitat for desert mule deer as well as pronghorn.

50 CFR §402.01 directs federal agencies to carry out conservation programs for listed species under the Endangered Species Act. Conservation is "...to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures of pursuant to this Act are no longer necessary." The BLM and other federal agencies are responsible for assisting the U.S. Fish and Wildlife Service (USFWS) with actions that support the recovery of threatened and endangered species [Section 7(a) 1]]. This project is designed to improve ecosystem processes and conditions that support federally listed species and designated critical habitats and lessen the need to list species in the future.

This project conforms to the goals and objectives of the Sonoran Desert Conservation Plan, Pima County (2001) through the maintenance and improvement of ecosystem structure and functions necessary to ensure the long-term survival of the full spectrum of plants and animals that are indigenous to Pima County. Specifically, the pertinent objectives of the Sonoran Desert Conservation Plan include:

1. Promote recovery of federally listed and candidate species to the point where their continued existence is no longer at risk.
2. Where feasible and appropriate, re-introduce and recover species that have been extirpated from this region.
3. Maintain or improve the status of unlisted species whose existence in Pima County is vulnerable.
4. Identify biological threats to the region's biodiversity posed by exotic and native species of plants and animals, and develop strategies to reduce these threats and avoid additional invasive exotics in the future.
5. Identify compromises to ecosystem functions within target plant communities selected for their biological significance and develop strategies to mitigate them.
6. Promote long-term viability for species, environments, and biotic communities that have special significance to people in this region because of their aesthetic or cultural values, regional uniqueness, or economic significance.

1.6 Scoping and Public Involvement

1.6.1 Public Scoping

The BLM has held multiple meetings with partner organizations and stakeholders on the proposed project and issues to be analyzed. On April 18, 2019, the agency presented an outline of the project description at the Spring Biological Planning meeting held on the Las Cienegas NCA. The BLM held a follow-up meeting on May 9, 2019, to allow for additional discussion and input on the proposed action and issues to be analyzed.

The BLM released Chapters 1 and 2 of the EA for a 15-day formal public scoping period in July and August 2019. The BLM received four comment letters during the 2019 formal public scoping period. Those comments helped inform the issues that were brought forward for detailed analysis and were also addressed in the draft EA. In January and February 2020, the BLM released the draft EA for a 15-day public comment period. The BLM received 16 comment letters in response to the 2020 draft EA which were primarily in support of the project. The BLM has been working with the USFWS since 2020 on the Section 7 consultation for this project. Through the Section 7 consultation process, the BLM made several revisions to the proposed action. As a result, the BLM released a revised version of the draft EA in April and May 2022. The BLM received four comment letters which were parsed into 38 substantive comments. The responses to those comments are in Appendix H.

1.6.2 Internal Scoping

The BLM held an initial interdisciplinary team meeting on October 10, 2018, to scope issues internally. Additional internal scoping occurred in May 2019, when the BLM broadened the proposed action to include riparian and mesquite bosque vegetation treatments, erosion control, and stream restoration (see Section 2).

1.6.3 Issues Considered but Eliminated from Detailed Analysis

The following list outlines resource issues that were considered through internal or external scoping and were eliminated from further analysis with a brief rationale that describes why the associated impacts would not be significant.

How would the proposed action affect air quality in the project area airshed?

Rationale for elimination: Dust generated during fuel reduction treatments would not be produced in sufficient quantities to affect air quality. Mesquite shrublands in the Chihuahuan Desert have been shown to have greater amounts of wind erosion than grasslands sites (Gillette and Pitchford 2004), thus maintenance of grasslands with the removal of mesquite through the proposed action may lead to reductions in wind erosion and improvements in air quality. Prescribed burning activities (pile burning) are permitted through the ADEQ which would ensure that thresholds for regulated air pollutants are not crossed. Implementation of best management practices (BMPs) Air Quality (AQ)-01 through AQ-04, would further reduce impacts (Appendix B).

What would be the impact of the proposed action on livestock grazing in the project area?

Rationale for elimination: The BLM has a good working relationship with the grazing lessees in the proposed treatment area. These lessees have been actively involved in the planning and comment process and support the proposed treatment projects to improve the health of the land. Working together with the lessees, the BLM would consider the grazing system and rotation that is used and can plan the implementation without hindering the grazing operation.

The BLM would work with the grazing lessees to develop an implementation plan that would work with each of their grazing schedules. For grazing deferments both prior to and following treatments, the BLM and lessee would work together to ensure that the treatment would not cause unnecessary stress to the grazing operation.

How would the use of heavy equipment for the mechanical removal of target species affect the potential spread of nonnative invasive weed infestations?

Rationale for elimination: Some invasive and/or noxious weeds are present in previously disturbed areas, including along existing roads and drainages. Ground-disturbing activities can create conditions that could increase the potential for introduction and/or establishment of nonnative plants. However, because BLM would comply with all federal, state, and local weed control regulations, including the project BMPs listed in Appendix B, the potential for spread of invasive and/or noxious weeds would be very low. Given the challenges associated with Lehmann lovegrass control, effects from the spread of this species are analyzed in detail (see Section 1.6.4 and Section 3.2).

How would the proposed action affect cultural resources in the project area?

Rationale for elimination: BLM-funded or jurisdictionally approved vegetation management and/or landscape restoration projects are considered undertakings subject to compliance with Section 106 of the National Historic Preservation Act (NHPA; 54 USC 306108 et seq.) and its implementing regulations at 36 CFR 800. Newly proposed actions as described in this EA would be subject to individual project review and assessment in accordance with the BLM's Arizona Vegetation and Range Management Programmatic Agreement (PA; executed September 30, 2020, see Appendix F). The BLM's primary and preferred methods to protect historic properties is avoidance of impacts through redesign or relocation of proposed activities and/or facilities. Should the BLM identify potential impacts to historic properties, the BLM may, accordingly, redesign or relocate proposed activities or constructions; or develop plans to mitigate potential adverse effects in consultation with the State Historic Preservation Office, Tribes, and other potentially affected parties.

For projects involving any jurisdictional entity who is not currently a party to the BLM's Arizona Vegetation and Range Management PA, that entity would be invited to participate. In the event that any jurisdictional entity declines PA participation, the BLM would negotiate applicable compliance procedures to either follow the BLM's Arizona Statewide Protocol (executed December 14, 2014, see Appendix G) or standard compliance procedures as directed under 36 CFR 800.

How would the proposed action impact paleontological resources in the project area?

Rationale for elimination: Before implementing watershed improvement or vegetation treatment projects, the BLM would review statewide potential fossil yield classification (PFYC) data. Proposed ground-disturbing activities located within geologic units classified as having high or very high fossil potential (PFYC 4 or 5) would be subject to further evaluation by a qualified paleontologist. The BLM's primary and preferred method to protect significant fossil resources is avoidance of impacts through redesign or relocation of proposed activities and/or facilities. Should impacts be unavoidable, the BLM would implement mitigation (typically via data recovery) in accordance with the Paleontological Resources Protection Act (PRPA; 16 U.S.C. § 470aaa 1-11).

Would the project affect soil and water resources from constructing erosion control and stream restoration structures?

Rationale for elimination: Implementing erosion control and stream restoration techniques would have a net benefit on soil and water resources. For instance, similar upland structures in neighboring watersheds were found to trap sediment and increase infiltration (Polyakov et al. 2014; Nichols et al. 2016; Norman et al. 2017; Norman et al. 2019). The impacts from temporary access roads used in construction are expected to be minimal and short term with implementation of the BMPs (Appendix B). A Clean Water Act Section 404 permit and 401 certifications would be acquired for projects located within waters of the U.S., or their applicable tributaries. The projects would conform to the standard and supplemental stipulations noted in the permits.

How would the project affect Tribal uses or interests?

Rationale for elimination: The BLM initiated government-to-government consultation with 10 Native American Tribes who claim cultural affiliation to and/or traditional use of the project planning area. Letters summarizing the proposed action were sent to the Fort Sill Apache Tribe, Hopi Tribe, Mescalero Apache Tribe, Pascua Yaqui Tribe, San Carlos Apache Nation, Tohono O'odham Nation, Tonto Apache Tribe, White Mountain Apache Tribe, Yavapai-Apache Nation, and Zuni Tribe on October 1, 2021.

The Tohono O'odham Nation responded via phone message on October 5, 2021, therein requesting additional information on the proposed plan and expressing interest in receiving copies of future, related cultural and biological resources assessments for review and consultation. The Yavapai-Apache Nation responded via email on October 18, 2021, stating that the Tribe had no concerns or comments, therein deferring to the San Carlos and Mescalero Apache Tribes. The White Mountain Apache Tribe responded via letter dated October 22, 2021, stating that the proposed plan posed no adverse effect to the Tribe's cultural heritage resources and/or traditional cultural properties. The Hopi Tribe responded via letter dated October 23, 2021, requesting hard copies of the proposed plan and draft EA, along with their interest to develop an Assistance Agreement to participate in implementation-level resource studies. To date, no other responses or comments have been received; however, Tribal consultation is considered ongoing and will continue throughout plan implementation.

Currently, there are no known or likely impacts to any culturally significant plants, items, sites, or landscapes. Any new information provided by consulting Tribes could prompt issue(s)-analysis and/or alternatives development. Likewise, the BLM may later apply additional or edited terms and conditions of project implementations or require mitigation to protect or restore culturally significant resource values.

1.6.4 Issues Identified for Analysis

The following lists the issues that were identified in either internal or external scoping efforts. They are analyzed in detail in Chapter 3 to either make a reasoned choice between alternatives or to determine the significance of the impact.

Soils and Water

- What would be the impact of large-scale vegetation treatment techniques, particularly prescribed fire and herbicide application, on downstream water quality?
- How would the change in vegetation communities affect runoff and sediment yields?
- What are the impacts of mechanized equipment, both those with tracks and with rubber tires, on soils, particularly in loamy bottom ecological sites?

Vegetation

- How would the proposed vegetation treatments and erosion control projects affect upland and riparian vegetation communities across different timescales?
- What would be the impact of the proposed vegetation treatments on nontarget native vegetation?
- How would the proposed treatments increase the spread of Lehmann lovegrass?
- How would the proposed treatments affect wetland plant communities and the Huachuca water umbel?

Wildlife/Threatened and Endangered Species

- How would heavy equipment, chain saw noise, and associated human activity affect migratory bird, general wildlife, and threatened, endangered, and sensitive species behavior, health, and distribution?
- How would the removal of vegetation, including upland, wetland, and riparian, affect habitat (breeding habitat, nesting habitat, hiding cover, and thermal cover) for migratory birds, general wildlife species, and specifically threatened, endangered, and sensitive species?
- What impact would the proposed vegetation management and treatments and erosion control projects have on wetland plant communities, aquatic habitat, aquatic (fish, amphibians, and aquatic reptiles) species, including threatened and endangered species and their critical habitats?
- How would upland treatments change sediment load and water quality in Cienega Creek and Empire Gulch?

Visual Resources

- How would the impact from large-scale vegetation treatment techniques affect the viewshed of riparian and upland communities in the project area?

Recreation

- How would the proposed action affect special recreation permittees, such as bird dog user groups and endurance horse riders?
- How would the impacts of the proposed vegetation treatments affect dispersed recreation users, such as hunters, campers, and OHV users?

2 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

The proposed action is for the BLM, in coordination with adjacent landowners, to implement landscape-scale mechanical, chemical, and prescribed fire treatments to achieve vegetation management objectives. Additionally, the proposed action is also to implement erosion control projects designed to reduce or eliminate accelerated erosion in the project area (Figure 3). The vegetation management objectives are outlined in Appendix A.

The BLM, in cooperation with various partner agencies and organizations, would implement vegetation treatments throughout the Las Cienegas Restoration project area, by using one or more of the following methods:

- BLM owned or rented equipment and agency personnel
- Vegetation treatment contracts, including stewardship and service contracts
- Resources from other federal, state, county, city, and private landowners, nonprofit groups, businesses, and permittees (with in-kind services, matching funding) using interagency agreements, memorandums of understanding, and multi-agency or multi-landownership partnerships

Specific integrated vegetation management practices could be implemented individually or in combination to meet objectives. Adaptive management strategies would be used to administer appropriate treatment methods. Treatments would be designed to use the least impactful methods first, then treatment effectiveness would be evaluated, and methodologies would change to more intensive methods if treatment objectives are not met. If effectiveness monitoring indicates that re-seeding or erosion control or soil compaction mitigation is required, those rehabilitation methods would be prescribed for each future treatment.

2.1.1 Proposed Annual Treatment Acreages and Unit Selection

Based upon the total estimate of acres that are not meeting the objectives of the RMP (Table 3), the maximum annual acres of treatments are provided below. In many cases these are overestimations of the actual annual treatments, but they are necessary to understand the spatial scope of the proposal and to assess the impacts to natural resources. In designing treatments, vegetation communities that share borders may be treated provided the treatment type is applicable to both vegetation communities. For instance, a prescribed fire in the uplands may be designed to encompass a nearby loamy bottom site if a necessary containment road encompasses both communities in the burn area.

Table 4. Maximum Acres of Each Vegetation Community Treated Per Year

		Maximum Acres Treated Per Year						
		Initial Treatment		Maintenance Treatment				
Vegetation Community	**Target Species**	**Herbicide**	**Mechanical (Grubbing)**	**Prescribed Fire**	**Manual**	**Targeted Grazing**	**Total**	**Percent of Total Area**
Scrub Uplands	Creosote Acacia	5,000	--	3,000	--	--	8,000	9%
Desert Grassland Uplands	Mesquite	2,000	3,000	10,000	--	--	15,000	14%
Riparian	Tamarisk Vinca	5	--	--	2	--	7	0.5%
Loamy Bottoms	Mesquite	500	125	2500	--	--	3,125	19%
Cienegas	Bulrush* Johnson Grass	8	Infrequent (IF)	3	4	11	26	8%

Treatment Unit Selection

Criteria Across All Vegetation Communities

Treatment units would be selected and designed based on an interdisciplinary team review. At a minimum, team members would review the following criteria to determine if a treatment is appropriate:

- Based on the most current land cover models and field observations, is the proposed treatment unit meeting the applicable objectives described in the RMP objectives or objectives from plans of other relevant jurisdictions (Appendix A)?
- Is the proposed treatment meeting the site-specific objectives for applicable ecological sites within the treatment area (such as those developed by Pima County)?
- Is the proposed treatment method the most appropriate, based on target species, soil type, topography, weather, and other site characteristics?
- Does the proposed treatment area have culturally sensitive areas that need to be avoided or need additional design features to eliminate or mitigate impacts?
- Have considerations for threatened and endangered wildlife and other special status species been taken into account when designing the treatment unit and selecting the appropriate treatment method and timing? Has the treatment unit been presented to USFWS at an annual meeting?
- Are native seed sources available in the proposed treatment unit and are they in sufficient quantities to allow natural vegetation reestablishment?
- Does this area have remnant patches or communities of native perennial grasses and other desirable species that could be affected or improved by treatments?
- In loamy bottom sites, has depth to water and occurrence of flooding been considered when considering treatment objectives?
- Would the treatment predispose the proposed treatment unit to invasion by exotic plants, particularly Lehmann lovegrass?
- In areas with grazing allotments, can livestock management be structured to allow recovery of the treatment unit to meet rangeland health standards, including hydrologic function, soil stability, and biotic integrity?

Selection Criteria Specific to Vegetation Community

Scrub Uplands

Treatments in the ecosites grouped under scrub uplands would be identified primarily based on whether adequate perennial grass cover is present to allow for a prescribed fire. It is assumed that many of these sites would not have the required perennial grass cover thus an initial herbicide treatment would be required to reduce shrub cover and increase perennial grass cover. Once sufficient grass cover is established, prescribed fire would be used as a maintenance treatment. It is estimated that roughly 5,000 acres per year of herbicide treatment (broadcast aerial) and 3,000 acres per year of prescribed fire (for maintenance) would be used in these sites.

Desert Grasslands

Treatments in the ecosites grouped as desert grasslands would require a variety of treatment techniques based on their location, mesquite cover, and mesquite growth form. Areas with high perennial grass cover and low mesquite cover would be treated with prescribed fire. As the amount of mesquite increases and the individual tree size increases a more extensive toolbox of treatment techniques would be required. Approximately 11% of these sites have crossed the 35% threshold (Gori & Enquist 2003), these sites either would not be treated, or they would require intensive treatment techniques and considerably more time. Estimates on annual acreages are based upon past treatments' success, on the ground knowledge, and expert opinion. Therefore, it is estimated that 2,000 acres per year would be treated with herbicide (cut-stump, basal bark, foliar spray, or broadcast ground), 3,000 acres per year would be mechanically treated, and 10,000 acres would be treated as maintenance with prescribed fire.

Loamy Bottoms (Mesquite Bosque & Sacaton Grasslands)

The treatments in loamy bottom ecological sites depend on whether the site potential is to be a grassland (sacaton), or forestland (mesquite bosque). Site specific data was available for areas of the NCA for this specific ecological site, thus information from those studies is used to determine percentages and annual acreages for each treatment technique. Treatment areas outside of the field inventoried acres would undergo a similar exercise to determine treatment prescription before treatment (see evaluation criteria section). This includes an assessment of depth to water, flooding potential, sacaton cover, and mesquite cover and growth form.

It is anticipated that sacaton grassland sites that are consistent with the historical climax plant community (HCPC) or with low mesquite cover (A, B1 sites from Tiller et al. 2012b, see Figure E-1, Appendix E,) would only require prescribed fire as a maintenance treatment. Areas with larger mesquite cover (B2 & B3) would require additional treatment types including herbicide (cut-stump, basal bark, foliar spray, or broadcast ground) in addition to prescribed fire. The areas labeled as sacaton-mesquite (C1 & C2) have larger growth form mesquites and therefore, these are the areas of the loamy bottom sites (8.3% of the total) that would require the use of mechanical methods in addition to the herbicide and prescribed fire. E1 and E2 would only require prescribed fire as a maintenance treatment.

Treatments in mesquite bosque sites would consist of thinning to reduce the densities of mesquite to be within the density objectives while still maintaining the canopy cover. The methods described above for manual, mechanical, prescribed fire, and herbicide in the upland areas would also be used to meet the objectives in loamy bottom ecological sites. These objectives and treatments are to promote a historical density of approximately 220 trees per acre, or a distance between trees of 16 to 20 feet (The Nature Conservancy 2018a). Mesquite bosque density data for the project area is not available to make an estimate of the departure of these sites. Potential treatment acreages are therefore based on the heavily departed sacaton grassland sites that have transitioned to a forestland site because of an assumed higher-than-the-objective density as these sites transition. Based on the departure analysis in Section 1, around 14.6% of the areas are estimated to be highly departed sacaton grassland sites (C1 & C2) that have transitioned over to a forestland, or mesquite bosque, potential community. It is completely possible that ecosites that are classified as being in the B1 and B2 state would not have the hydrologic properties necessary for successful sacaton grassland restoration, these areas would be identified in pre-treatment field investigations.

It is estimated that a maximum of 2,500 acres of loamy bottom sites would be treated annually with prescribed fire, a maximum of 500 acres would be treated annually with herbicide, and a maximum of 125 acres would be treated mechanically annually. Since cienegas, or wetlands, are associated with sacaton grasslands, wetlands located in loamy bottom ecological sites would be burned as a single unit.

Riparian

Contained mostly within sandy wash ecological sites, riparian is defined here as forested cottonwood-willow-ash (or similar) sites near perennial or intermittent stream reaches. A state and transition model for typical sites was developed specific to the Las Cienegas NCA in 2008 (see Bodner and Simms 2008). The proposed treatments in these areas include tree plantings, selective hinge-felling, and invasive plant removal (manually or with herbicide). The best available data that captures the extent of the riparian in the project area is from the US Forest Service Region 3 Riparian Potential dataset (Triepke et al. 2018). This dataset indicates an acreage of 1,457 acres in the project area. A departure analysis across the project area is not available. The previously mentioned 2008 study on riparian forest status in the Las Cienegas NCA indicated improvement in general riparian health in the NCA from the mid 1990's to 2008. Therefore, treatments in these areas would be limited to site-specific areas of currently known invasive species presence such as vinca removal near Empire Gulch Spring, and tree plantings near potential future sites vulnerable to disturbance (e.g., fire), or in conjunction with other treatments (erosion control/stream restoration as described below).

Cienegas

Annual acres for each treatment technique are determined by goals and objectives related to the establishment or maintenance of suitable habitat for priority species at individual cienegas. Cienegas outside of the Las Cienegas NCA are likely to have the same treatment prescription used to meet similar objectives. Cienegas to be treated would be evaluated for surface water depth (summer), plant community composition, presence of invasive plants (e.g., bulrush, cattail, Goodding's willow, Johnson grass, etc.), and emergent plant cover in open water. Treatments in wetland areas would be limited to site-specific areas of currently known invasive species presence such as Johnson grass removal from Cieneguita Wetlands and the three wetland exclosures, and Spring Water Wetland. Bulrush and cattail control would occur at these same locations with the addition of Cinco Wetlands.

Fire would be applied to all the loamy bottom floodplain wetlands adjacent to Cienega Creek and lower Empire Gulch when that option is available as part of prescribed fire for grassland management. It is anticipated that 3 acres of cienega would be burned as part of a 3–5-year fire rotation.

When considering herbicide treatments, active ingredients that are not BLM-approved for use in riparian and aquatic areas would require the use of minimum herbicide-free buffers based on the application method: 100 feet for aerial applications, 25 feet for vehicle applications, and 10 feet for hand spraying applications. Greater herbicide-free buffers may be utilized if the risk assessment guidance for each proposed active ingredient dictates it is needed or if deemed necessary during the IDT review process based on topography, soil type, and target species of a planned treatment area.

Treatment Method Selection

The BLM would determine, in collaboration with other partner jurisdictions where relevant, a treatment method by considering such factors as the treatment unit size, effectiveness of the treatment, impact of the treatment, and the resources available for that treatment method. Treatment locations and acreages to be treated within any one year would depend on availability, need, and funding. Future treatment areas could be identified when the need arises to meet resource objectives.

Once the BLM has evaluated a proposed treatment using these criteria, it would review the treatment through a Determination of NEPA Adequacy (DNA) to ensure NEPA compliance with this EA. This DNA review would ensure that the specific potential impacts of the proposed treatment have been sufficiently analyzed. If the BLM determines a proposed treatment to have impacts that have not been analyzed in this EA, the BLM would prepare a new NEPA document.

2.1.2 Annual Coordination with Fish and Wildlife Service

The BLM would coordinate annually with USFWS on site-specific implementation of vegetation treatment and erosion control projects in the action area. This coordination would occur prior to implementation of any treatment activities to identify site-specific measures to protect federally listed species and ensure compliance with the Biological Opinion (BO) from USFWS.

2.1.3 Application of Best Management Practices and Conservation Measures

The BLM has developed best management practices (BMPs) specific to the Gila District over time, through the planning and implementation of various land treatment projects and consultation with USFWS. These BMPs would be applied to the proposed action, when applicable, to minimize potential impacts on resources. An IDT would identify the proposed treatment units and associated treatment methods and then determine which BMPs and Conservation Measures (CMs) are applicable for each treatment.

2.1.4 Treatment Methods

Prescribed Fire Treatments

Prescribed fire treatments to modify, thin, reduce, or remove fuels and reduce or remove undesirable woody plant species in treatment units are as follows:

<u>Broadcast burning</u> - Using handheld or aerial ignition devices, apply prescribed fire treatments across the landscape to meet resource objectives. To minimize the need for hand line construction, burn plan boundaries would be aligned with natural and man-made features, such as roads, washes, areas with naturally sparse fuels, and rocky areas. Areas of ground disturbance, such as hand line construction and staging areas, would be subject to individual cultural and paleontological resources assessment prior to implementation.

Since prescribed fire treatments in the Cienega watershed area depend largely on continuous fine fuels (grasses) to carry fire, it would be necessary to defer grazing beforehand. Deferment periods would be at a minimum of one growing season before treatment. This would be done to allow for an adequate amount of fine fuels growth in the treatment unit. Following the prescribed fire treatment, cattle would be excluded from the treatment unit for a minimum of two growing seasons (July-December) or until resource conditions are met as outlined in this EA and the Las Cienegas RMP to allow for perennial grasses to grow and drop seed before cattle enter the unit. The BLM would coordinate with the grazing lessees to develop an implementation plan that would work with each of their grazing schedules. For grazing deferments both prior to and following a prescribed fire treatment, the BLM and lessee would work together to ensure that the treatment would be at the appropriate time and would not cause unnecessary stress to the grazing operation.

<u>Slash pile burning</u> - Using handheld devices, apply prescribed fire treatments to hand- or mechanically-assembled slash piles generated during treatments. Hand- or machine-assembled slash burn piles would be in areas that limit or remove the potential for fire or heat to affect canopy, structures, or other surrounding vegetation. Slash is generally burned during the fall and winter, when cooler temperatures and higher humidity reduce the potential of fire spreading into adjacent fuels.

Wetland burning - Using handheld or aerial ignition devices to apply fire over discrete areas encompassing one or more wetland patches in a wetland complex. Wetlands and associated plant communities may be burned simultaneously. Wetlands are generally burned when dry and brown in fall or winter.

All prescribed fire treatments (broadcast and pile) would be conducted under a site-specific prescribed fire burn plan. This plan would specify the weather and fuel conditions, fire behavior modeling, holding resources, and preparation, such as what sites would be protected and line construction needed to meet the treatment objectives safely and efficiently. The burn plan would identify any agencies, permittees, or other interested parties to be notified concerning the prescribed fire project. It would include other land management agencies, when applicable, to work cooperatively across ownership boundaries. It also would identify any potential receptor sites and smoke management mitigation measures necessary to minimize impacts on the airshed and receptor sites. Hand- or machine-assembled slash burn piles would be in areas that limit or remove the potential for fire or heat to affect canopy, structures, or other surrounding vegetation. Slash is generally burned during the fall and winter, when cooler temperatures and higher humidity reduce the potential of fire spreading into adjacent fuels.

Mechanical Treatments

Mechanical treatments would modify, thin, reduce, or remove vegetation using heavy equipment. This could be done using tracked and rubber-tired vehicles, such as track hoes, backhoes, front-end loaders, skid steers, and trucks, all outfitted with special attachments suited for the specific treatment action. Low ground pressure tires and tread would be used on soils where warranted to reduce the potential for soil compaction (i.e., on moist soils with a high clay content). Mechanical treatment techniques include the following:

Mastication - Using equipment with special attachments for mulching, chipping, mowing, grinding, or thinning.

Grubbing - Using rubber-tired or tracked equipment for removing entire plants and root balls.

Thinning - Using rubber-tired or tracked equipment to thin trees, remove dead and down fuels, gather and move slash into piles or windrows, and remove slash from treatment site.

Wetland site and wildlife pond treatment - Grubbing or thinning of vegetation (trees or bulrush root balls) would only be done in instances where bulrush or cattail root balls have occluded open water and cannot be removed by hand or handheld equipment. On soft or saturated soils, soil compaction would be reduced or prevented using wood mats or other tread pressure reducing devices (e.g., excavator pads, crane mats, swamp mats, tundra mats, etc). This work would be conducted between October 1 and March 15. Treatments would typically last one day per site and two days for larger wetlands.

Manual Treatments

Manual vegetation treatments aim to modify, thin, reduce, or remove vegetation using hand tools. These could be hand tools, such as Pulaskis, McLeods, axes, shovels, and hand saws, or power tools, such as chainsaws, weed trimmers, field and brush mowers, and other specialized equipment. Although the manual method of vegetation treatment is relatively labor intensive and costly, it can be extremely species selective and well suited to areas with sensitive habitat, cultural resources, or where vehicular access may be restricted.

Hand tools and chainsaws would be used to remove salt cedar (tamarisk), periwinkle (*Vinca major*), Johnson grass, and riparian trees invading cienegas and other wetland types. Hand-, gas-, or battery-powered weed eaters would be used in or near wetlands to control invasive stands of bulrush, cattail, invasive riparian trees, and Johnson grass. Locations where these treatments are necessary include, but are not limited to, the three restored wetland ponds in the Cieneguita Wetlands, the Spring Water Wetland, wildlife ponds in the action area, and the Cinco Canyon wetlands. Invasive wetlands plants may be pulled or cut by hand on banks and underwater. These treatments may also be used on ponds and wetlands on Pima County properties such as Hospital Tank on Clyne Ranch, Goat Well on Sands Ranch, various ponds/tanks at Bar V Ranch, or other locations. Submersible weed eaters may be employed to cut bulrush and cattails below the surface. This work would occur during the growing season from May 1 to September 1 annually to control herbaceous vegetation. Treatments may occur three to five times annually per wetland. Treatments are expected to last about one day per site but may take multiple days on the largest wetland sites treated.

Hinge-felling of willows may be used in incised channels to promote vertical growth across the middle of the stream course. This would help capture flow and sediment, reduce incision, and increase wetted stream length.

Herbicide Treatments

Herbicide treatments would modify, thin, reduce, or remove targeted vegetation through application of chemical herbicides. Herbicides could be applied in either liquid or granular form within treatment units. All proposed herbicides (Table 5) have been approved for use on BLM-administered public lands as documented in the Programmatic Environmental Impact Statement (PEIS) for Vegetation Treatments Using Herbicides on BLM Lands in 17 Western States (BLM 2007) and PEIS for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on BLM Lands in 17 Western States (BLM 2016a). Various manufacturers offer multiple products under varying trade names that include the active ingredients listed in Table 5. The BLM conducted risk assessments prior to approving each active ingredient (USDI BLM 2007; 2016a). The risk assessment for each active ingredient discloses potential impacts to resources and the mitigation measures that must be followed when using the active ingredient, including Best Management Practices (BMPs) as described in Appendix B.

Herbicides are categorized as selective or non-selective: selective herbicides kill only a specific type of plant, and non-selective herbicides kill all types of plants the herbicide contacts. Some herbicides are post-emergent, which means they can be used to kill existing vegetation, while others are pre-emergent, which stops vegetation from growing above the soil surface.

Adjuvants (Table 6) may be used with these herbicides to approve application and herbicidal activity. The ratio of adjuvant to herbicide varies as determined by the BLM and by the species of vegetation to be controlled, application method, application technique, and label requirements. Table 6 lists the proposed adjuvants.

Treatment of invasive species in upland, wetland, and riparian sites would be on a case-by-case basis dependent on regular field and post-treatment monitoring. Any invasive species identified in the future in Arizona Department of Agriculture or US Department of Agriculture (USDA) weeds lists would also be considered for early detection rapid response (EDRR) and control/eradication, using BLM-approved herbicides (see BLM 2007, BLM 2016a).

Herbicides may be applied in liquid or granular form via the following application methods:

Spot treatment—Herbicides would be applied selectively to only target species in a localized manner. This is generally done as an on-the-ground treatment on only the target species. Spot treatment applications can be applied by a handheld bottle sprayer, backpack sprayer, UTV-mounted sprayer, vehicle mounted sprayer, herbicide roller, or paintbrush. Spot treatment methods include the following:

- Cut-stump—Herbicides would be applied directly to cambium layer of the fresh, flush-cut stump of various tree and shrub species. Herbicides are spot applied using a backpack sprayer, a handheld bottle sprayer, an herbicide roller, or a paintbrush.
- Basal bark—Herbicides would be applied directly to the basal area of small tree, shrub, and grass species; this technique is generally used on saplings, re-sprouts, or low-growing species with thin bark. Herbicides are spot applied using a handheld bottle sprayer, a backpack sprayer, or a sprayer mounted on a regular vehicle or a utility terrain vehicle/all-terrain vehicle (UTV/ATV).

- Foliar—Herbicides would be applied directly to the foliage of target species; this technique is generally used on the canopy layer of small trees and shrubs that are no taller than 6 feet, or on non-native invasive grasses and forbs. For spot application, herbicides could be applied using a handheld bottle sprayer, a backpack sprayer, or a sprayer mounted on a regular vehicle or a UTV/ATV.
- Aquatic system spot application—Herbicides approved for use in aquatic systems would be used to spot treat salt cedar (tamarisk; *Tamarix* spp.), periwinkle (*Vinca major*), Johnson grass (*Sorghum halepense*), and invasive riparian trees encroaching on cienegas, other wetland types, and wildlife ponds. Potential areas include but are not limited to: Cienega Creek (on BLM-administered and Pima County Regional Flood Control District lands); Empire Gulch, Mattie Canyon, and Gardner Canyon on BLM-administered lands; and Davidson Canyon on Pima County lands.

Broadcast Application – Broadcast application of pelletized tebuthiuron, i.e. Spike 20P, would be applied at a rate of 0.5 pound (lb) active ingredient (a.i.)/acre (0.56 kilogram (kg) a.i./hectare) or less to the soil to treat creosote bush and white thorn acacia in the scrub upland community (Table 4). Site-specific buffers would be developed for each treatment (see BMP WR-01 in Appendix B.11). At a minimum, areas within 984 feet (300 meters) on both sides of perennial waterways, 100 feet (30.5 meters) on both sides of other drainages, 100 feet (30.5 meters) buffers around springs and wells, and any areas with a slope greater than 15% would be excluded from broadcast herbicide treatment. According to label specifications, tebuthiuron is most effective when applied before the primary growing season or before expected seasonal rainfall. To avoid herbicide runoff during monsoon storms, tebuthiuron would be applied to the soil in fall through early spring (10/1-3/31) before low-intensity winter rainstorms for incorporation into the soil for root uptake by shrubs in the spring. Tebuthiuron would be broadcast with ground (truck, UTV, or ATV-mounted spreader) or aerial (rotor-wing or fixed-wing aircraft) applicators with a global positioning system (GPS) and calibrated emitters to ensure only intended areas are treated and that the intended volume of herbicide is applied.

Table 5. List of Proposed Herbicides (active ingredients) and Potential Target Species

Mesquite	Salt Cedar	Creosote/Acacia	Vinca
Triclopyr Clopyralid Aminopyralid	Imazapyr Glyphosate	Tebuthiuron	Glyphosate Imazapyr

Table 6. List of Proposed Adjuvants[1]

Adjuvant	Description
Colorant	A dye added to herbicide mixtures to identify where herbicides have been sprayed.
Suspension agent	This helps active herbicide ingredients stay suspended in the formulation and prevent caking or settling at the bottom of the container.
Emulsion agent	This is a substance that can dissolve in oil or water; and allows oil to be uniformly dispersed in water as an emulsion.
Non-ionic surfactant	This is a surfactant used in herbicide mixtures to help break down the surface tension of plants and trees to promote herbicide absorption.
Methylated seed oil	This product is derived from the reaction of a fatty acid (from seed oils) with methyl alcohol and usually contains emulsifiers and surfactants. Its primary use is with systemic post-emergent herbicides, insecticides, and fungicides.
Crop oil	Crop oil or crop oil concentrates are petroleum-based additives used to increase the efficacy of herbicides in agricultural applications.
Water	Water can be used in place of or in combination with oils to increase the efficacy of herbicides.

[1] Any substance in a herbicide formulation or added to the spray tank to improve herbicidal activity or application characteristics.

Planting and Seeding

This treatment involves the planting and seeding of native riparian and flood plain species where the percentage of riparian vegetation below potential natural community and groundwater levels is enough for plant species survival. Irrigation may be used, if necessary, for establishment.

- Reseeding/planting sacaton plugs and erosion control structures in areas that are not meeting RMP objectives in loamy bottom sites, particularly bare ground cover, and where the depth to water is less than 16 feet.

Targeted Livestock Grazing in Wetlands

Livestock grazing in selected wetlands and wildlife ponds would be used to treat invasive and crowding species such as bulrush, cattail, and Johnson grass in or near wetland and wildlife ponds to maintain native wetland plant diversity, open water habitat for fish and frog species, and habitat diversity for wetland and aquatic species. This method of control would not be used in Cienega Creek or Mattie Creek. It would be limited to restored and artificially created wetlands and ponds (Table 7).

- Livestock would be allowed entry to grazing exclosures with critical habitat and/or occupied habitat only to control unwanted vegetation and for a maximum of 4 weeks (typically treatments would take 2 weeks) between March 1 and August 30. The livestock would be removed promptly after treatment objectives (acres of unwanted vegetation are removed) are achieved. The treatment objectives would depend on the size of the area (anywhere from 1 to 30 acres) being treated. Number of livestock would be limited to the minimum number of livestock needed to achieve objectives. Specific goals and guidelines would be written and clearly communicated to the lessee prior to the treatment. Vegetation and livestock would be monitored by BLM Rangeland Management Specialist(s) and a BLM Biologist until the treatment objective is met.

- At Egret, Heart, and Crescent wetlands, livestock would be allowed entry to the area within the exclosure but not within the fences directly around the three ponds (each pond has its own fence around it and the livestock would not be allowed within those individual pond fences).

- Temporary or permanent fencing would be used to control the extent of the grazing. The primary species that need to be controlled are Johnson grass, bulrush, and cattail. These plant species are very palatable to livestock and grow tall enough to make them preferred over most other species (Simms 2019).

- Livestock would be excluded from any populations Huachuca water umbel, Arizona eryngo, or Canelo Hills ladies' tresses.

- Targeted livestock grazing treatments may require further treatments such as herbicide application, hand removal, or mechanical removal alone or in combination.

Table 7. Potential wetland/pond locations for targeted livestock grazing treatments.

Wetland / Pond	Location (Lat., Long)	Acres (approximate)
Egret, Heart, Crescent wetland (Cieneguita)	31.795342, -110.597946	30
Cottonwood pond	31.761209, -110.619608	1

Erosion Control and Stream Restoration

The proposed action for reducing accelerated erosion in the project area is to implement erosion control and induced meandering treatments of various types, such as rock/vegetation and earth works, with different manual and mechanical methods. Figure 3 indicates some initial areas where these types of treatments would occur. These treatments could occur in all ecological sites including within stream channels and potentially across jurisdictional boundaries.

Outlined below are the purpose and general descriptions of each treatment method. Appendix C contains site-specific information for treatment areas with design plans.

Upland Manual Treatments

In smaller upland tributary drainages, the treatment is the placement of rocks or wood by hand in erosional features or channels. This prescription involves minor earth work with hand tools to reduce the grade of features or to prepare sites for treatment. Rock or wood structures would be similar to one-rock dams, Zuni bowls, rock rundowns, media lunas, baffles, vanes, wicker weirs, or log mats similar to those outlined in Zeedyk and Clothier (2009). (See Appendix C for site-specific designs and additional information on treatment techniques.)

During treatment construction, materials would be staged in designated areas and temporary roads would be required. Denuded staging areas and temporary roads would be remediated after construction. This could include raking tracks, mulching, reseeding, or other techniques proven to be effective for remediation.

Upland Mechanical Treatments

In a limited number of areas, where the above manual treatments are not practical, specifically on larger head-cuts (>4 feet deep) and erosion features, the treatment prescription would involve the use of heavy equipment to reduce the grade of erosional features before a protective layer is put in place. This layer could be made up of properly placed plant material, rocks, mulch, or soil tackifiers.

In areas where sheet erosion occurs and placing rocks or plant material is not a practicable approach, the BLM could use such techniques as counter ripping (key line plowing) and emplacing berms or using other comparable methods proven to be effective.

Hydro-seeding, defined as a combination of mulch, seed, and water applied across a large area, may also be required in areas with extensive sheet erosion. This would include reseeding/planting of native grasses appropriate to the site.

Stream Restoration

The goal of the stream restoration is to return a stream channel to a former, or better, functioning state by increasing floodplain connectivity and geomorphic complexity. In general, techniques that promote natural processes would be preferred. These include in-stream structures composed of natural materials, principally wood and rock, and created by hand. These are identified in Appendix C.

In a limited number of areas experiencing vertical or lateral erosion, cross vanes and weirs composed of rock or wood, as illustrated in Appendix C, would be used. Previous successful treatments in Cienega Creek near the agricultural fields consisting of cross vanes built with 24 to 48-inch diameter boulders were constructed in 1997. Like the previous treatments, these techniques can require mechanized equipment and temporary access roads for construction.

The BLM would use cross vanes and weirs, composed of boulders or sufficient diameter logs, or other techniques proven to be effective to control vertical and lateral erosion. The BLM also would use such techniques to improve habitat in mainstream courses: Cienega Creek, Empire Gulch (head cut below the 900 road crossing), Gardner Canyon, and Mattie Canyon. These techniques require mechanized equipment and temporary access roads. (See Appendix C for an example of a cross vane and for proposed stream restoration treatments). These restoration techniques would be applied at other locations as the need arises. Additional NEPA analysis or environmental compliance would be necessary for activities with additional disturbances not analyzed within this EA.

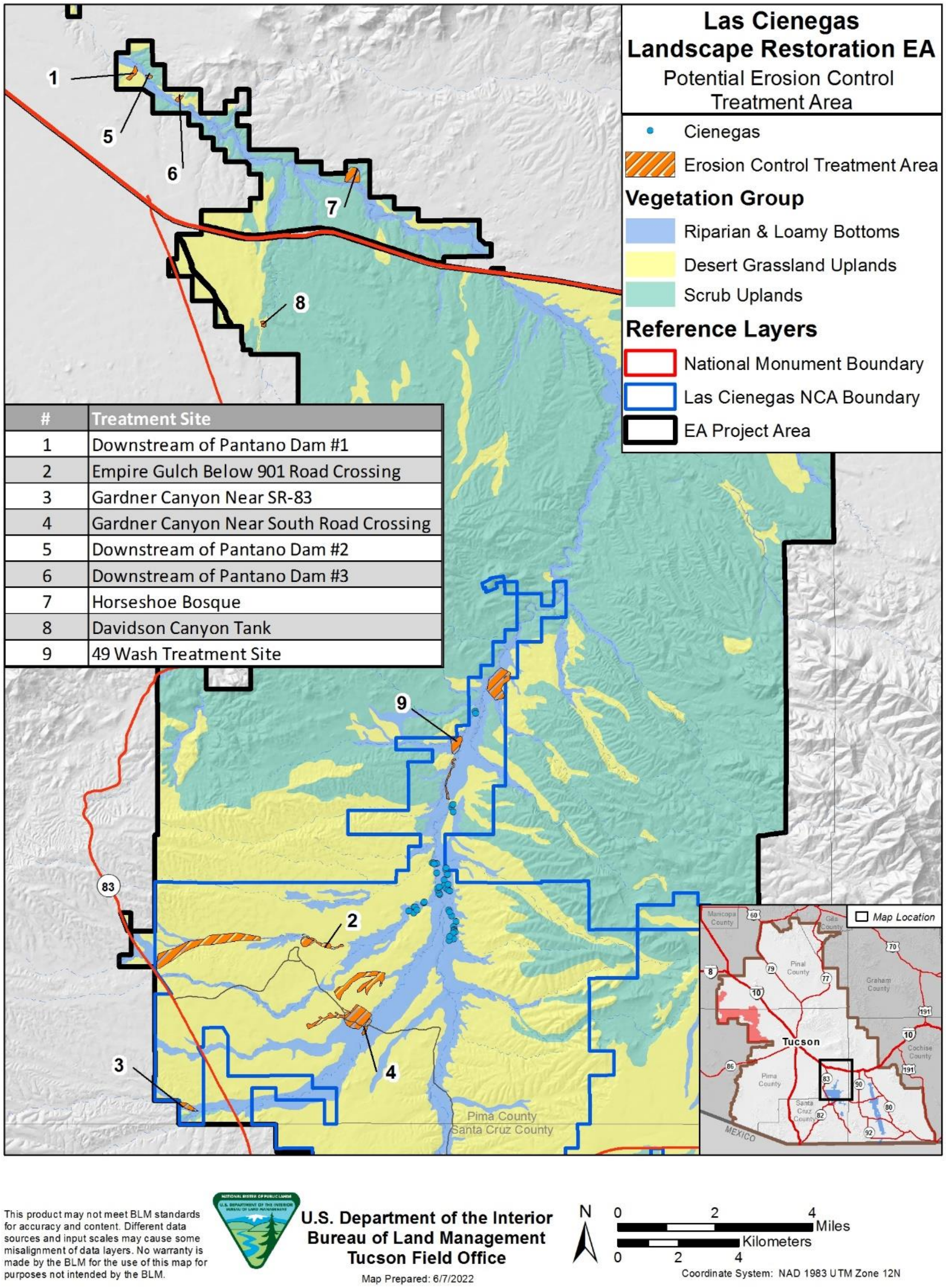

Figure 3. Landscape Restoration EA – Location of Proposed Erosion Control Projects

Erosion Control & Stream Restoration Treatment Areas

Erosion Control Project Areas

Several initial erosion control projects have been designed and those areas are indicated in Figure 3. Summaries of the site designs for the proposed erosion control projects are detailed below.

- Downstream of Pantano Dam #2 (number 5 on Figure 3) – This 1.5-acre property would require approximately 36 rock structures constructed with 125 cubic yards of rock. The construction would occur with a crew of 8 people over the course of 8 to 10 days. Rock would be delivered by vehicular access along Cienega Creek.
- Downstream of Pantano Dam #3 (number 6 on Figure 3) – This treatment would construct 100 rock structures on the 3.5-acre parcel with 125 cubic yards of rock. The construction would be completed with a crew of 8 over a course of 6 to 8 days. Rock would be delivered by vehicular access along Cienega Creek.
- Horseshoe Bosque (number 7 on Figure 3) – This treatment would use approximately 50 brush structures (media lunas and weirs) constructed from dead mesquite limbs. Treatment would involve 8 people with one chainsaw operator over the course of one week.
- Davidson Canyon Tank (number 8 on Figure 3) – This treatment would implement approximately 15 rock structures downstream of the stock tank. The rock would be delivered via gravel road access directly to the tank.
- 49 Wash (number 9 on Figure 3) – This treatment would utilize approximately 60 rock structures (zuni-bowls, media lunas, one-rock dams) to treat head cuts on BLM lands in the Las Cienegas NCA. It would take the use of 200 cubic yards of rock deposited just off access road 6907A (49 Wash road).
- Downstream Pantano Dam #1 (number 1 on Figure 3) – This 10.5-acre site would have approximately 110 rock structures (media lunas and one-rock dams). This treatment would use 150 cubic yards of rock and 3 people for 20 days.
- Empire Gulch below 6901 Crossing (number 2 on Figure 3) – This treatment would utilize 150 cubic yards of rock to construct approximately 80 rock structures (zuni bowls and one rock dams). The treatment would consist of 3 people over the course of 20 days.
- Gardner Canyon near State Route 83 (number 3 on Figure 3) – This treatment would utilize approximately 75 rock structures (zuni bowls, one-rock dams, and media lunas). This treatment would utilize 150 cubic yards of rock deposited near the access road. The treatment would consist of 3 people for 20 days.

Other Erosion Control / Stream Restoration Areas:

- These areas are identified in Figure 3 that are depicted as “Erosion Control Treatment Areas” in the legend but do not have a number associated with them. They indicate areas that have been identified as needing treatment either in the past (e.g., Ag Fields Group Site), explicitly mentioned in the RMP (e.g., Wood Canyon), or identified in preparing this EA. The methods used in these areas will be the same as those highlighted above.

Erosion Control / Stream Restoration Treatment Acreages & Future Estimates

The total acreage from the erosion control and stream restoration projects identified above is 864 acres. In addition to these identified sites, erosion control measures identified above may be used as part of a vegetation treatment. It is expected that 1% of the vegetation treatment acreage (see Table 4 above) would require re-seeding or planting of native grasses for erosion control purposes. Under the assumption that the maximum number of treatments would be completed, and that 1% of the vegetation treatment acreage would require re-seeding or planting, it is expected that 32 acres of loamy bottoms, 80 acres of scrub uplands, and 150 acres of desert grassland would need re-seeding or planting every year. Furthermore, it is expected that a separate 1% of the vegetation treatment acreages would require other mechanical or manual erosion control treatment techniques implemented at the same time, or slightly after.

Table 8. Maximum Annual Erosion Control and Stream Restoration Treatment Acres by Vegetation Community

Vegetation Community	Acreage of Erosion Control Project Areas	Vegetation Treatment Acreage that Requires Re-seeding/ Planting	Vegetation Treatment Acreage that Requires Manual/ Mechanical Erosion Control	Total Erosion Control/Stream Treatment Acres
Scrub Uplands	20	80	80	180
Desert Grassland Uplands	409	150	150	709
Riparian	36	5	>1	41
Loamy Bottoms	399	32	32	464
Total	**864**	**269**	**262**	**1,394**

2.1.5 Treatment Site Monitoring, Rehabilitation, and Maintenance

Pre-Treatment and Post-Treatment Monitoring

The treatment units identified for each of the treatment methods are based on monitoring data taken at each ecological site. The BLM will use Assessment, Inventory, and Monitoring (AIM) Protocols (BLM 2017 and 2019e) to assess the pre-treatment level of departure and post-treatment effectiveness.

In upland erosional features, the BLM would establish photo points before treatment and would monitor the points to determine treatment effectiveness and maintenance requirements.

Post-Treatment Rehabilitation

Post-treatment rehabilitation is contingent on immediate post-treatment monitoring. Ingress/egress routes would be rehabilitated before the monsoon season. The BLM also would conduct surveys for ground-nesting birds before rehabilitation. If soil is eroding or is expected to erode, then rehabilitation would involve erosion control techniques similar to those described below: using rock structures, contour ripping, reseeding, and hydro mulching.

Treatment Site Maintenance

Upland Sites

The BLM would maintain units (including past units listed in the background section) to control resprouts and new growth of mesquite. The preference would be to use prescribed fire where applicable, but maintenance could be via herbicides or mechanical treatments. Maintenance of other vegetation treatments with different targets would also be completed in addition to control of mesquite. Maintenance treatments would also follow the same criteria described below under *Vegetation Treatment Unit Selection* to determine if a treatment is appropriate, including completing all applicable surveys and monitoring.

Vegetation maintenance would be required every 3 to 5 years on a unit-by-unit basis. It would be accompanied by a Determination of NEPA Adequacy (DNA) and pesticide use proposal (if using herbicide) and with an appropriate nest and burrow survey done before treatment.

Wetland Sites

The BLM would maintain treated wetlands units to control resprouts and new growth of Johnson grass, bulrush, cattail, vinca and other invasive species. Maintenance could be mechanical treatments, targeted grazing, herbicide or prescribed fire where applicable. Maintenance would be required every 2 to 5 years when using fire, annually when using herbicides, or as frequently as semi-annually when done manually (i.e. handheld implements and power-tools).

Erosion Control Sites

Maintenance would be based on monitoring data but would happen at least once in the first 5 years of installation. Maintenance could include using spot treatments with on-site materials or completely rebuilding structures with additional materials. Structures designed to trap sediment would need to be revisited, and new structures would be placed on top of the old to continue increasing bed elevations.

2.1.6 Sequencing, Timing, and Overlap of Treatments

Vegetation treatments generally consist of an initial treatment followed by maintenance treatments to ensure the vegetation community meets its objectives. For example, in mesquite invaded sacaton grasslands, mesquite bosques, and desert grassland upland vegetative communities, treatments to achieve a lower tree density would follow the sequence below.

Example:

- Year 1: Mechanical grubbing to reduce mesquite density and cover
- Years 3-4: Herbicide treatment to eliminate resprouted mesquite
- Years 8-9: Second herbicide application to treat resprouting mesquite
- Years 8-12: Prescribed fire to treat resprouting mesquite

Treatments in riparian areas would also follow this sequence if target species are persistent over time. If the initial treatment method effectively eliminates the target species (e.g., tamarisk in riparian habitat), then subsequent maintenance treatment would not be required. However, in most instances, follow-up maintenance treatments are needed. Treatment units that require maintenance treatments receive multiple treatment actions over time.

2.2 No Action Alternative

Under this alternative, the BLM would not implement the proposed vegetation treatments or erosion control projects, nor would it maintain previous vegetation treatment areas. The agency could implement vegetation treatments that are identified under existing NEPA documentation (EA # 420-2006-19).

2.3 Alternatives Considered but Eliminated from Detailed Study

2.3.1 Maintain past treatments but don’t implement additional or new treatments

Rationale: The BLM considered an alternative under which past treatments would be maintained but additional treatments would not be implemented. This alternative was eliminated because it would not meet the purpose and need described in Section 1.2, as the vegetation and watershed objectives in the RMP would not be achieved.

2.3.2 Remove livestock grazing from Las Cienegas NCA

Rationale: The BLM considered an alternative under which livestock grazing would be removed from Las Cienegas NCA in response to comments that suggested removing livestock would improve the vegetation condition. Public Law (PL) 106-538, which established the Las Cienegas NCA, states: “The Secretary of the Interior shall permit grazing subject to all applicable laws, regulations, and Executive orders consistent with the purposes of this Act.” Thus, livestock grazing is a use that was accounted for in the enabling legislation for the Las Cienegas NCA. This alternative was eliminated from further analysis because permitted livestock grazing is adjusted when needed to comply with the Arizona Standards for Rangeland Health. This assessment and adjustment process is completed in association with livestock grazing lease renewals and is therefore not included in this analysis.

2.3.3 Significantly reduce the amount of livestock grazing on Las Cienegas NCA

Rationale: The BLM considered an alternative under which livestock grazing would be reduced on Las Cienegas NCA in response to public comments that suggested reducing livestock grazing would restore Las Cienegas NCA resources. Permitted livestock grazing is adjusted when needed to comply with the Standards for Rangeland Health. This assessment and adjustment process is completed in association with livestock grazing lease renewals and is therefore not included in this analysis. In addition, the BLM collects robust upland monitoring data every fall on Las Cienegas NCA, compares the monitoring data results to the Las Cienegas RMP objectives, and considers the monitoring data results in upcoming management decisions. This continuous feedback of monitoring data allows the BLM to make adjustments to the permitted livestock grazing on Las Cienegas NCA in response to resource concerns.

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3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Note that all tables referenced in this chapter can be found in Appendix E: Figures and Tables. The analyses for the no action alternative and proposed action address issues listed for each resource. These issues are addressed separately for the proposed action analysis but are combined for the no action alternative analysis.

Analysis Assumption

Proposed vegetation treatments in the upland scrub and desert grassland sites for all techniques (mechanical, fire, and herbicide) would be estimated to occur on a maximum of 23,000 acres annually, based on past treatment acreage and professional judgement.

3.1 Soil and Water Resources

- Issue 1: What would be the impact of large-scale vegetation treatment techniques, particularly prescribed fire and herbicide application, on downstream water quality?
- Issue 2: How would the change in vegetation communities affect runoff and sediment yields?
- Issue 3: What are the impacts of mechanized equipment, both those with tracks and with rubber tires, on soils, particularly in loamy bottom ecological sites?

3.1.1 Affected Environment

Soil and water resources are analyzed together here because of the inherent link between the soil conditions and hydrologic processes that are affected by the proposed action. This section establishes the baseline conditions of the affected environment for these resources in the project area as it relates to the issue statements above.

Soil Resources

The development of soils and their properties are a function of their parent material, topographic location, climate, and biotic community. These factors are interlinked and work across many timescales; thus, soil properties vary greatly across the landscape (Brady and Weil 2008). Because of this heterogeneity, soils with similar properties are often grouped into map units characterized by the dominate soil properties. Ecological sites are used to determine ecological potential for a given soil map unit, physical setting, and rainfall amount.

Major Land Resource Areas (MLRAs) are large geographic areas characterized by a particular pattern of soils, climate, water resources, land uses, and type of farming. Within the proposed project area, there are 215,587 acres in the Southeastern Arizona Basin and Range MLRA and 1,144 acres in the Sonoran Basin and Range MLRA (BLM GIS 2019). Ecological sites fall within MLRAs and are distinctive areas that produce different types and amounts of vegetation, depending on several factors such as soil properties, geology, and ability to respond to management actions and natural disturbances. Most of the ecological sites in the proposed action area are listed in Hernandez et al. 2013, including the ecological sites in MLRA 41, the Southeastern Arizona Basin and Range.

The ecological sites in the project area, as further described in the vegetation section (Section 3.2), have been broadly grouped into three vegetation types to facilitate vegetation management: desert grassland uplands; drainages, lowlands, and others; and scrub uplands. Soil orders and suborders in the project area are listed for the three vegetation types in Table E-3. Alfisols (0.4% of the project area) result from weathering processes that leach clay and minerals and other constituents out of the surface layer and into the subsoil, where they can hold and supply moisture and nutrients to plants. They form primarily under forest or mixed vegetation cover. Aridisols (68.4% of the project area) are too dry for the growth of terrestrial plants that are neither adapted to particularly dry nor particularly wet environments. The lack of moisture limits most soil development processes to the upper part of the soils. Entisols (12.3% of the project area) occur in areas where erosion or deposition rates are faster than the rate of soil development. Mollisols (18.9% of the project area) are quite fertile and have a moderate to pronounced seasonal moisture deficit (BLM GIS 2019; USDA undated). Wetland soils examined by USGS soil scientists indicated that several wetlands had an O horizon located below overlying sediment (BLM 2006). This horizon was identified as an aquent histisol that is saturated and likely occurs on less than 1% of the Las Cienegas NCA.

Soils can be susceptible to wind and rainfall erosion because of factors such as topography, vegetation type and density, and soil moisture regimes. Soils with similar properties have similar susceptibility to erosion by wind and rainfall. Soil series in the project area and their erosion hazard ratings are listed for the vegetation types in Table E-4. The soils are susceptible to erosion because of slope or texture. The erosion hazard ratings are soil interpretations from the Natural Resources Conservation Service (NRCS) Web Soil Survey. NRCS Erosion Hazard (off-road, off-trail) interpretation calculates this rating based on an assumed soil surface exposure from disturbance of 50-75%. A rating of “slight” indicates that erosion is unlikely under ordinary climatic conditions. A rating of “moderate” indicates that some erosion is likely and that erosion-control measures may be needed. A rating of “severe” indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised.

The erosion hazard within the proposed project area is severe for 18,646 acres, moderate for 73,066 acres, and slight for 124,546 acres (see Table E-4). This represents 9%, 34%, and 57% of the project area, respectively. Nearly all the soils with a severe erosion hazard are in the scrub uplands. The soil series that cover the largest areas are Bernardino-Hathaway association, rolling (15.21% of the project area), Deloro-Andrada complex, 5-35% slopes (10.16% of the project area), and Powerline-Kimrose family complex, 10 -35% slopes (7.67% of the project area). None of these have a severe erosion hazard rating.

The deep clay and loamy soils immediately next to portions of Cienega Creek and some of the major tributaries are highly susceptible to gully erosion and soil piping. One such area, Lower Wood Canyon, has severe gully erosion and piping on more than 200 acres. Several areas have large active gullies and deep holes resulting from continuing soil movement. In 1993, a large flood (greater than 100-year flood by volume) scoured Cienega Creek (MacNish et al. 1993), creating a 5-foot-deep head cut south of Springwater Canyon. This head cut was stabilized in 1994 (BLM 2002).

Water Resources

The project area is in the southern extent of the basin and range physiographic province, which is comprised of generally north-south trending mountain ranges with basins composed of pre-Basin and Range formation sediments and sediments eroded from weathering of the nearby ranges. These two fill components comprise the general basin fill system, which consists of heterogeneous layers of sand, gravel, and clay lenses (Anderson et al. 1989; Huth 1997). Another unit consisting of recent deposition with likely higher hydraulic conductivity sitting on top of the basin fill is known as near-stream alluvial aquifer. Conceptually, the groundwater system is comprised of water in the pore spaces of the basin fill and near-stream alluvial aquifer and in the fracture systems of surrounding bedrock mountain ranges and basin floor. In general, groundwater flow starts as recharge in the mountains then percolates through the aquifer until it is discharged as streamflow or consumed by near-stream riparian vegetation. Recent studies in parts of the upper Cienega Creek watershed have indicated that the water in the basin fill is primarily from mountain-front recharge and that surface water and shallow alluvial aquifer are primarily composed of water from this basin fill aquifer (Tucci 2018, Gray 2018). Pima Association of Governments has defined shallow ground water areas (depth to water less than 50 feet) for Pima county. In the planning areas these areas are lower, middle, and upper Cienega Creek, lower and upper Davidson Canyon, Barrel Canyon, and Gardner Canyon (Pima Association of Governments 2012). These shallow groundwater areas roughly correlate to the same areas as the Drainages and Lowlands Vegetation grouping and include the major surface water features described below. Precipitation, evapotranspiration, and groundwater pumping influence streamflow.

There are five watersheds in the project area. They are summarized in Table E-5.

Cienega Creek is one of the main drainages in the project area, with major tributaries of Gardner, Empire Gulch, Springwater, and Mattie Canyons in the upper portion and major tributaries of Davidson and Wakefield canyon in the lower portion. Cienega Creek originates in the Canelo Hills and continues roughly 50 miles toward north where it becomes the Pantano Wash in the Tucson Metropolitan Area. Bedrock emerges from the alluvium at the narrows causing perennial flow and serves to divide the upper and lower basins. Lower Cienega Creek continues northward through the lower alluvial basin until it bends west/northwest near Anderson and Wakefield Canyons. A bedrock below Interstate 10 forces flow upward again at the Cienega Creek Natural Preserve.

The Babocomari River is in the southeastern portion of the project area with its upper watershed in the Whetstone and Huachuca Mountains and the Canelo Hills. The 25-mile Babocomari River is one of the main tributaries to the San Pedro River to the east. It is classified as a predominantly ephemeral stream, but has perennial stretches that are supported by the regional groundwater system. O'Donnell Creek is in the planning area and is a tributary to the Babocomari River that supports roughly two miles of perennial surface water.

Significant springs in the Las Cienegas NCA include Cold Spring, Upper Empire Gulch Spring, Apache Spring, Post Canyon, Smitty Spring, Nogales Spring, and Little Nogales Spring. Perennial ponds include Clyne's Pond (Northwest Reservoir), Cienega Ranch Marsh, and five ponds in Cinco Canyon: #1, #2, #3, #4, and #7. Most developed springs have not been maintained and are used seasonally by wildlife and livestock (BLM 2002). Significant springs outside the Las Cienegas NCA but still in the proposed action area include Mescal Spring, Bobo Spring, Wakefield Spring, Apache Spring, and Cottonwood Spring (NHD [National Hydrography Dataset] GIS 2019). Within the proposed project area, there are 35 acres of perennial lakes/ponds and about 64 acres of intermittent lakes/ponds (BLM GIS 2019).

According to the USGS NHD stream classifications in the proposed project area, there are 20 miles of perennial streams, 312 miles of intermittent streams, and 1,267 miles of ephemeral streams (BLM GIS 2019). From 2006 to 2016, when GPS technology was employed to inventory surface water on an annual basis, total wetted stream varied between 4.7 and 7.8 miles for Cienega Creek and tributaries on the Las Cienegas NCA. Stream lengths in June (the minimum flow period) are as follows:

- Lower Cienega Creek is 1.2 miles (the average from 2014 to 2018), compared with roughly 7.2 miles for May 1990 (Pima Association of Governments 2018; Montgomery & Associates 1995).
- Upper Cienega Creek is 6.3 miles (the average from 2014 to 2018), compared with 9.98 miles in 1990 (BLM 2019a).
- Upper Babocomari River is 4.6 miles (2018) (The Nature Conservancy 2018b).
- O'Donnell Creek is less than 2 miles (2018) (The Nature Conservancy 2018b).

Cienega Creek, from its confluence with Gardner Canyon to the USGS gaging station at Pantano Wash (#09484600; approximately 28.3 river miles), is an outstanding Arizona water, which means it is a surface water that is classified as an outstanding state resource water (Arizona Department of Environmental Quality 2016). A portion of Lower Cienega Creek in the preserve is designated as a "Unique Water of Arizona" by ADEQ (Northern Arizona University 2019).

A disturbance ratio has been used before to indicate the initial disturbed acres versus those that are impacted by the structures overtime through changes in geomorphology (Ciotti 2020). This later area also defined as the 'zone of influence' of a structure or complex of structures on the stream channel and floodplain (Wheaton et al. 2019). Following this, treatments on smaller tributaries have a much smaller and comprise a much smaller 'zone of influence' than on mainstem areas of Cienega Creek. Thus, the acreage presented for treatments is not just physical area of the structures on the ground, but the general area impacted by construction and the general zone of influence expected from them.

3.1.2 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under this alternative, the BLM would not implement the proposed vegetation treatments or erosion control projects, and it would not maintain previous vegetation treatment areas. The agency could implement vegetation treatments that are identified under existing NEPA documentation (EA # 420-2006-19, EA # DOI-BLM-AZ-G020-0021, and EA # DOI-BLM-AZ-G020-2011-0028). The existing environmental compliance covers limited upland vegetation treatments in the original 20,000 acres identified in the Las Cienegas RMP (2003) and wetland vegetation maintenance by hand. Ongoing impacts on soil and water resources, as described in those existing NEPA documentations, would continue. The no action alternative would impact <1% of the project area with direct impacts from vegetation treatments and erosion control treatments.

There would be no new impacts on soil and water resources, and current impacts would continue involving large-scale vegetation treatments (implemented under existing NEPA documentation) and water quality; vegetation communities, runoff, and sediment yields; and mechanized equipment and soils. For example, not implementing treatments in areas outside the existing NEPA documentation would continue to allow those areas to transition further from the reference condition in their respective ecological site's state and transition model. This transition towards a more departed state is typically characterized as a shrub dominated or eroded state that has higher hydrologic susceptibility and thus increases in runoff and sediment loss for a given rain event (Williams et al. 2016, NRCS 2019).

Cumulative Impacts

The five watersheds overlapping the proposed action area (Table E-5) are the geographic scope of the analysis area for cumulative impacts.

Past, present, and future actions that have affected and would affect soil and water resources (water quality, runoff, water supply, and soil disturbance and compaction) include vegetation treatments, wildfires, livestock grazing, climate change, Forest Service vegetation treatments within a 90,000-acre project area (though not all acres would be treated) in the upper part of the watershed, restoration and erosion control projects on Pima County lands in the Cienega Creek Natural Preserve, off-road vehicle travel, and mining. Previously, the BLM completed vegetation treatments on approximately 19,500 acres (see Table 2) using prescribed fire, chemical, and mechanical methods in the Las Cienegas NCA. Erosion control and stream restoration projects have been constructed in Los Pozos Gulch, Mattie Canyon, and on Cienega Creek near the agricultural fields and its confluence with Springwater Canyon. Also, both the number of new wells drilled and the amount of pumping throughout the entire Cienega watershed have increased significantly since 2000 (Powell 2013, Cienega Watershed Partnership 2018).

Construction and operation of the Rosemont Copper Mine have the potential to change surface water discharge to Davidson Canyon and Cienega Creek. It also has the potential to increase sediment and pollutant transport to surface water features and degrade water quality (Shafiqullah et al. 2017). Modeling of groundwater drawdown from construction and operation of the open-pit mine indicates a potential reduction in streamflow in Davidson Canyon, Empire Gulch, and Cienega Creek (USDA 2017).

Past, present, and future actions have affected and would affect soil and water resources by removing vegetation, altering the composition of vegetation, disturbing the soil surface, and reintroducing beaver that alter water flow and sources. In addition, changing conditions such as increases in temperature and shifts in precipitation patterns that support vegetation health and spread would also affect soil and water resources. Because there would be no new direct and indirect impacts from the no action alternative, there also would be no new cumulative impacts from the no action alternative.

3.1.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Issue 1: What would be the impact of large-scale vegetation treatment techniques, particularly prescribed fire and herbicide application, on downstream water quality?

Broad prescribed fire and herbicide use temporarily remove all the vegetation and lead to the creation of a contaminant source in the form of exposed soil, ash, debris, and possibly herbicides. Selection of treatment areas for the proposed action would follow considerations listed in Section 2.1.1 under Proposed Annual Treatment Acreages and Unit Selection and best management practices in Appendix B: Best Management Practices, discussed immediately below.

Appendix B for the proposed action contains management practices to minimize the degree of potential negative impacts, to the extent possible. These practices, for example, would leave a buffer between treated hillslopes and drainages to aid in minimizing sediment and herbicide transport to these areas. Furthermore, surface runoff would decrease over time as vegetation becomes reestablished in areas treated by broad prescribed fire and herbicides.

Prescribed Fire

As part of a prescribed fire, hand lines may be constructed to control the planned burn area. Hand line construction involves the direct removal of vegetation and top layers of soil using typical hand tools. This type of surface disturbance can increase the potential for erosion and can alter water movement involving infiltration and runoff. The area of this type of impact is relatively minimal compared to the acreage of a typical burn unit. Furthermore, burn units are typically demarcated by already defensible controls such as roads, thus the length of hand line creation is further minimized.

The erosion hazard within the proposed project area is severe for 18,646 acres, moderate for 73,066 acres, and slight for 124,546 acres (see Table E-4). This represents 9%, 34%, and 57% of the project area, respectively. Nearly all the soils with a severe erosion hazard are in the scrub uplands, and 93% of the soils with a moderate erosion hazard are also in the scrub uplands. The desert grassland uplands contain 76% of the soils with a slight erosion hazard. Surface disturbances, such as from prescribed fire, would have the most impact in areas with severe and moderate erosion hazards.

The heat from a wildfire has the potential to sterilize soil, increase soil hydrophobicity, and inhibit vegetation growth. This typically occurs with high fuel loads, longer burn times, and limited soil-moisture availability (Neary et al. 2008). A study that included prescribed burning practices in the Santa Rita Experimental Range did not find any visible indications of impacts on soil minerals or soil hydrophobicity from the fire (Fields et al. 2011). Depending on the vegetation and seasonal timing of the prescribed fires, impacts on soils from excessive heat may occur in limited areas where fuels have accumulated under dense shrub or tree patches.

Regarding post-fire runoff, prescribed fire is expected to reduce vegetation cover and consume accumulated litter in the short term. The reduction in vegetation can allow for the more water to be stored in soil as transpiration is temporarily reduced (Fields et al. 2011). A study with burn plots in the Santa Rita Experimental Range and Empire-Cienega found more water can be stored in soil following a fire due to the absence of vegetation (Seyfried and Wilcox 2006). Also, Neary et al. (2008) indicate that prescribed fires with low-intensity burns typically do not alter watershed conditions enough to cause a significant increase in peak flows. A study in the Santa Rita Experimental Range found runoff and sediment delivery within the natural range of variability of the unburned plot after a controlled burn, concluding that rainfall variability was an essential component to determining erosion rates (Emmerich and Cox 1992). For proposed action areas with higher slopes than the noted study, a short-term decrease in vegetation cover could cause increases in rainfall-induced runoff and sediment delivery downstream.

Robinett (1994) studied how frequently fires can burn the major range sites at Fort Huachuca without long-term negative impacts on the soils or plant communities. The four range sites sampled included loamy upland, sandy loam upland, loamy hills, and granitic hills. All but loamy hills are in the Las Cienegas proposed action area. In loamy upland, the surface needs to be protected by grass or gravel, or both, to prevent accelerated erosion from fire. This is because the site naturally produces a lot of runoff. In sandy loam upland, there is little runoff and no signs of accelerated erosion from fire. In granitic hills, areas with thick tree cover typically do not have adequate grass cover to protect the soil from significant erosion following a fire. Table E-6 further characterizes the baseline erosion and runoff conditions for ecological sites. These conditions influence how surface disturbances, such as prescribed fire, would affect erosion and runoff.

Ash can settle on surface waters during active burning, be carried there by wind, and be transported by runoff. Excessive amounts of ash can increase the pH of surface waters and, along with sediment, increase turbidity (Neary et al. 2008). The degree to which water quality is degraded depends on multiple factors, including the extent and intensity of the fire, post-wildfire precipitation, watershed topography, and local ecology (USGS 2019).

Herbicide

The impacts from herbicide application as described in the proposed action to soil and water resources are described below. In essence the BLM relies on the analysis in the 2007 and 2016 BLM Herbicide PEIS and would use BMPs (Appendix B) to minimize and reduce impacts.

The BLM would follow the Record of Decision (ROD) for the Final Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (BLM 2007), which is incorporated here by reference. That ROD states the following regarding impacts on soil and water (page 4-7):

> None of the herbicides commonly used by the BLM appear to result in adverse impacts to soil. Of the herbicide active ingredients most often used by the BLM, picloram and tebuthiuron are persistent in soil for a year or more, while clopyralid, glyphosate, and 2,4-D are relatively non-persistent in soil. Potential effects to soil and soil organisms from these herbicide active ingredients and the new herbicide active ingredients appear to be minor. Several herbicide active ingredients have been identified as groundwater contaminants (e.g., 2,4-D, glyphosate, picloram, simazine). The BLM will adhere to herbicide product labels with regards to application restrictions associated with groundwater protection and will use other SOPs and mitigation measures to further reduce risks to groundwater. Effects to surface water would be minor, and herbicide concentrations in surface water should not exceed safe levels for human health. There is potential for herbicides to be transported in surface water and impact non-target vegetation and the BLM will use buffers to reduce or avoid this risk.

The BLM would follow the ROD for the Final Programmatic Environmental Impact Statement (PEIS) for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on BLM Lands in 17 Western States (BLM 2016a), which is incorporated here by reference. That ROD states (page 4-2):

> All three of the new herbicides, have relatively short half lives in soil, although aminopyralid can be persistent under certain site conditions and plant materials, and residues that have been treated with aminopyralid may continue to release the active ingredient into the soil until they have decomposed. Potential effects to soil and soil organisms from the three new herbicide active ingredients appear to be minor. Although not currently identified as groundwater contaminants, the three new herbicides have the potential to become groundwater contaminants. The BLM will adhere to herbicide product labels with regards to application restrictions associated with groundwater protection and will use other SOPs and mitigation measures to further reduce risks to groundwater. Fluroxypyr and rimsulfuron have a low risk of surface water runoff. Aminopyralid has a high risk of surface water runoff, but is of low toxicity to aquatic systems. The BLM will maintain suitable buffers between treatment areas and surface water bodies, dependent on herbicide- and site-specific criteria.

In Tebuthiron treatments of creosote in New Mexico, infiltration rates were higher immediately post treatment, this is speculated to be from higher litter amounts caused by vegetation defoliation (Perkins and McDaniel 2005). Aerial herbicide use can also remove all vegetation in a treated area. Reclaim (clopyralid) and Remedy (triclopyr) are moderately residual in soil, plants, and water sources. This requires precautions to prevent spray drift (Tiller et al. 2012a).

The proposed action includes a maximum of 15,503 acres per year of prescribed fire as maintenance treatments that would impact a maximum of 7% of the planning area annually. Similarly, the proposed action includes a maximum of 7,513 acres per year of prescribed fire as maintenance treatments that would impact a maximum of 3.5% of the planning area annually. The impacts to water quality from prescribed fire and herbicide treatments, as described above would occur both within and downstream of the project area.

Issue 2: How would the change in vegetation communities affect runoff and sediment yields?

The proposed action would change the composition of vegetation communities in the proposed project area. As a result, the amount of water available as runoff would change. This is because runoff is affected by a variety of factors, including infiltration, the uptake of water by vegetation, the physical coverage of the soil surface by vegetation, and soil being held in place by vegetation. Grass, forb, or litter canopy can protect bare ground (soil) beneath them from the erosive impacts of raindrops (Gori and Schussman 2005). Both infiltration and resistance to flow are higher on grasslands than on shrublands. Where shrubland has replaced grassland during the past century, the ground surface has become more exposed to raindrop impact and overland flow has increased in volume and velocity. Increased runoff and erosion in inter-rill areas occur because of decreased resistance to overland flow and decreased run-on infiltration (Abrahams et al. 1995). These changes have resulted in accelerated erosion in the form of rill development, widespread stripping of the topsoil, and the formation of desert pavement in inter-shrub areas (Abrahams et al. 1994; Abrahams et al. 1995). Landscape restoration actions would restore vegetation conditions that reduce runoff and sediment transport.

According to Weltz et al. (2014), for many arid and semiarid western rangeland soils, the sustainable soil loss rate is estimated to be less than or equal to 2.2 tons per hectare per year due to their shallow depth, low organic matter content, and the slow rate of soil formation in erratic and dry climates. Weltz et al. (2014) propose that soil loss rates of 2.2 to 4.5 tons per hectare per year put the long-term sustainability of these rangelands at risk and that soil loss rates of greater than 4.5 tons per hectare per year be considered unsustainable. The ecological sites found in both Hernandez et al. (2013) and Table E-6 cover approximately 78% of the proposed action area. Of the ecological sites not found in Hernandez et al. (2013), the loamy bottom sites have both the most area and potential for erosion in the proposed action area based on Table E-6. Maintaining grass coverage and preventing sites from entering eroded states would maintain these levels of sediment yield. Where possible, it would also maintain sites in their reference state (Williams et al. 2016). Treatments that result in Lehmann lovegrass (*Eragrostis lehmanniana* Nees) expansion may have increased sediment yields compared to a reference state with native bunchgrasses (Polyakov et al. 2010).

Average annual soil erosion rates and their variabilities for ecological sites are identified in Figure 8 in Hernandez et al. (2013), which is incorporated here by reference. It relies on the rangeland hydrology and erosion model using Natural Resources Conservation Service National Resources Inventory data. The clayey slopes 12- to 16-inch precipitation zone ecological site has the highest erosion rate within the first and third quartile, but it is not in the proposed action area. Except for this ecological site, all the ecological sites within the first and third quartile in Hernandez et al. (2013) have erosion rates less than 2.2 tons per hectare per year. Sites with clay are more susceptible to soil erosion because of their fine soil texture, while upland gravelly loam sites have considerable rock fragments that reduce erosion potential (see Table E-6).

The proposed action would change the composition of vegetation communities in the proposed project area. This would affect water supplies because different plants use different amounts and sources of water. Vegetation in the uplands do not have access to groundwater. Evapotranspiration is, therefore, limited by precipitation and not vegetation. In the uplands, vegetation treatments such as mesquite removal would not increase water supplies. This is because of the high potential evapotranspiration[2] rate; however, mesquite removal in the lowlands could increase streamflow.

Vegetation in the lowlands has access to shallow groundwater and, therefore, potential evapotranspiration rates are dependent on vegetation type and not precipitation. Grassland relies primarily on recent precipitation (Scott et al. 2000). This is because herbaceous vegetation has a shallower effective rooting depth. As a result, the amount of soil water potentially available for transpiration is reduced and more is available for deep drainage (Seyfried and Wilcox 2006) and subsequent use by mesquite. Mesquite obtains water from deeper in the soil profile (Scott et al. 2000). Streamflow is expected to decline as a result of woody plant encroachment in landscapes dominated by subsurface flow regimes. Encroachment of woody plants can be expected to produce an increase in the fractional contribution of bare soil evaporation to evapotranspiration in semiarid ecosystems (Huxman et al. 2005). The replacing of mesquite with grass can result in an increase in water supplies due to changes in evapotranspiration rates (Leenhouts et al. 2006).

Issue 3: What are the impacts of mechanized equipment, both those with tracks and with rubber tires, on soils, particularly in loamy bottom ecological sites?

Mechanized equipment can involve the use of either tracks or rubber tires. These forms of locomotion affect soils differently. Their use would vary based on site conditions and the type of work being performed.

Vegetation treatments that use ground-disturbing equipment create impacts on soil resources by displacing vegetation and decreasing vegetation ground cover, causing compaction and displacement of soil due to vehicle tracks and uprooting of trees and shrubs. Soil compaction decreases total pore space, water infiltration rates, and gas exchange, all of which are important for healthy functioning soil. This leads to a reduction in soil productivity and an increase in ponding and runoff rates and the associated soil erosion by water. Vegetation treatments using rubber-tired vehicles and tracked vehicles compact soils differently. Tracked vehicles may compact the soil to a higher degree but would compact less area. This is because tracked vehicles can pull or push a tree over from a single position. Rubber-tired vehicles are lighter and compact the soil less, but they lack power and require multiple approaches from various sides to pull or push a tree over, thereby compacting soil in a greater area. Low ground pressure tires and tracks would be used on heavy equipment to lower or eliminate compaction risk.

Due to slope and soil conditions, the runoff-generating process in the uplands of the semiarid basins is dominated by infiltration excess[3] (rather than saturation excess). Compaction in the uplands can further reduce the infiltration capacity and cause more runoff per precipitation event. Tiller et al. (2012b) found that ground surfaces at grubbed sites had 12.3% and 5.3% soil disturbance. In the lowlands, the fine soils with their high silt and clay content and greater water-holding capacity are more vulnerable to erosion and soil compaction, making some ground-disturbing mechanical treatments unsuitable (Tiller et al. 2012a). Vehicle use in the lowlands would have a greater impact on compacting soil than in the uplands.

It is important to note that only select areas would be treated using mechanical grubbing. Mechanical grubbing is effective at reducing mesquite cover and lowering rates of resprouting, but it creates brush piles and soil disturbance in rough proportion to the amount of original mesquite cover on a site (Tiller et al. 2012b). In the short term, mechanical grubbing (particularly involving large root ball removal) would disturb the soil profile and infiltration rates, leading to increased runoff rates and soil erosion. These impacts would lessen as grasses become established and the site approaches reference conditions. Site characteristics, such as slope, would influence the use of mechanical grubbing.

Desert soil surfaces are generally covered with biological soil crusts that are vital in creating and maintaining soil fertility in desert soils (Belnap 2003). Soil crusts are fragile and have relatively slow recovery times. The main threats to crust integrity include heavy livestock grazing, high-severity fires, and

[2] The amount of evaporation that would occur if a sufficient water source were available.
[3] Ponding and runoff occur when precipitation exceeds the infiltration capacity of the soil.

mechanical disturbance such as off-road vehicle traffic, especially when occurring during or followed by a dry period (Forest Service 2017). Grazing has limited the presence of biological soil crusts in the proposed action area. Vehicle traffic compacts biological soil crusts. Compaction influences soil water and nutrient-holding capacity. Surface disturbance also decreases water infiltration and increases runoff (Belnap et al. 2001).

Cumulative Impacts

The five watersheds overlapping the proposed action area (Table E-5) are the geographic scope of the analysis area for cumulative impacts. Past, present, and future actions are described above under Section 3.1.2: Impacts from the No Action Alternative.

Past, present, and future actions have affected and would affect soil and water resources by removing vegetation, altering the composition of vegetation, disturbing the soil surface, and reintroducing beaver that alters water flow and sources. In addition, changing conditions such as increases in temperature and shifts in precipitation patterns that support vegetation health and spread would also affect soil and water resources. Over the long term, the proposed action would restore vegetation communities and would not degrade landscape conditions. The proposed action would have countervailing cumulative impacts on soil and water resources because it would reduce the impacts from past, present, and future actions by restoring the landscape over the long term.

3.2 Vegetation

- Issue 1: How would the proposed vegetation treatments and erosion control projects affect upland, riparian, and cienega vegetation communities across different timescales?
- Issue 2: What would be the impact of the proposed vegetation treatments on nontarget native vegetation?
- Issue 3: How would the proposed treatments increase the spread of Lehmann lovegrass?
- Issue 4: How would the proposed treatments affect wetland plant communities and the Huachuca water umbel?

3.2.1 Affected Environment

The planning area supports a variety of plant communities, many of which have been altered from their historical extent and composition due to human development, historic overgrazing, changes in climate, and other impacts. Within the planning area, there are 33 different ecological sites spanning three precipitation zones, in addition, the planning area includes five of the rarest vegetation communities in the desert Southwest: semidesert grasslands, sacaton riparian grasslands, cienegas, mesquite bosques, and cottonwood-willow riparian communities (BLM 2003; NRCS 2019). Table E-1 and Figure 4 provide an overview of major vegetation types in the project area. National Resources Conservation Services ecological sites describe the potential vegetation, and a full description of each ecological site is available on the National Resources Conservation Services website (NRCS 2019). The ecological sites have been broadly grouped into four vegetation types to facilitate vegetation management: 1) deciduous riparian; 2) desert grassland uplands; 3) loamy bottoms; and 4) scrub uplands (Table E-1). In addition, wetland/cienega vegetation community has been mapped on 38 acres of the project area (Table E-7).

Existing Vegetation Condition

Scrub Uplands

This vegetation community often occurs as invasive upland shrublands, with mesquite (*Prosopis* spp.) and other deep-rooted shrubs, such as whitethorn acacia and creosote, able to exploit deep-soil moisture that is unavailable to grasses and cacti. Vegetation is typically dominated by velvet mesquite, whitethorn acacia, and succulents. Grass cover is typically low and composed of desert grasses such as false fluffgrass (*Dasyochloa pulchella*), Porter's muhly (*Muhlenbergia porteri*), and tobosa grass (*Pleuraphis mutica*).

Desert Grassland Uplands

Common grass species of the semidesert grasslands include tobosa (*Pleuraphis mutica*), three-awn (*Aristida purpurea*), muhlys (*Muhlenbergia* spp.), and gramas (*Bouteloua* spp.). Shrubs include velvet mesquite (*Prosopis velutina*), acacias (*Acacia* spp.), mimosa (*Mimosa* spp.), and creosote bush (*Larrea tridentata*) (Arizona Important Bird Areas Program 2018). This vegetation community provides important habitat for many species, such as pronghorn, serves as a habitat corridor linking adjacent mountain ranges, and is maintained by natural processes such as fire (Gori and Enquist 2003).

Native semidesert grasslands are rare in the region, covering only 15% of the areas where such communities once occurred. The composition and structure of semidesert grasslands have been altered in many areas due to shrub encroachment, loss of perennial grass cover, and nonnative species spread, such as Lehmann lovegrass. Most shrub-invaded grasslands with the potential for restoration are located on public land, providing a substantial opportunity to improve conditions on BLM-administered lands (Gori and Enquist 2003). During the last century, the area occupied by this system has decreased through conversion of desert grasslands to shrublands as a result of drought, overgrazing and honey mesquite seed dispersion by livestock, and/or decreases in fire frequency (NatureServe 2019).

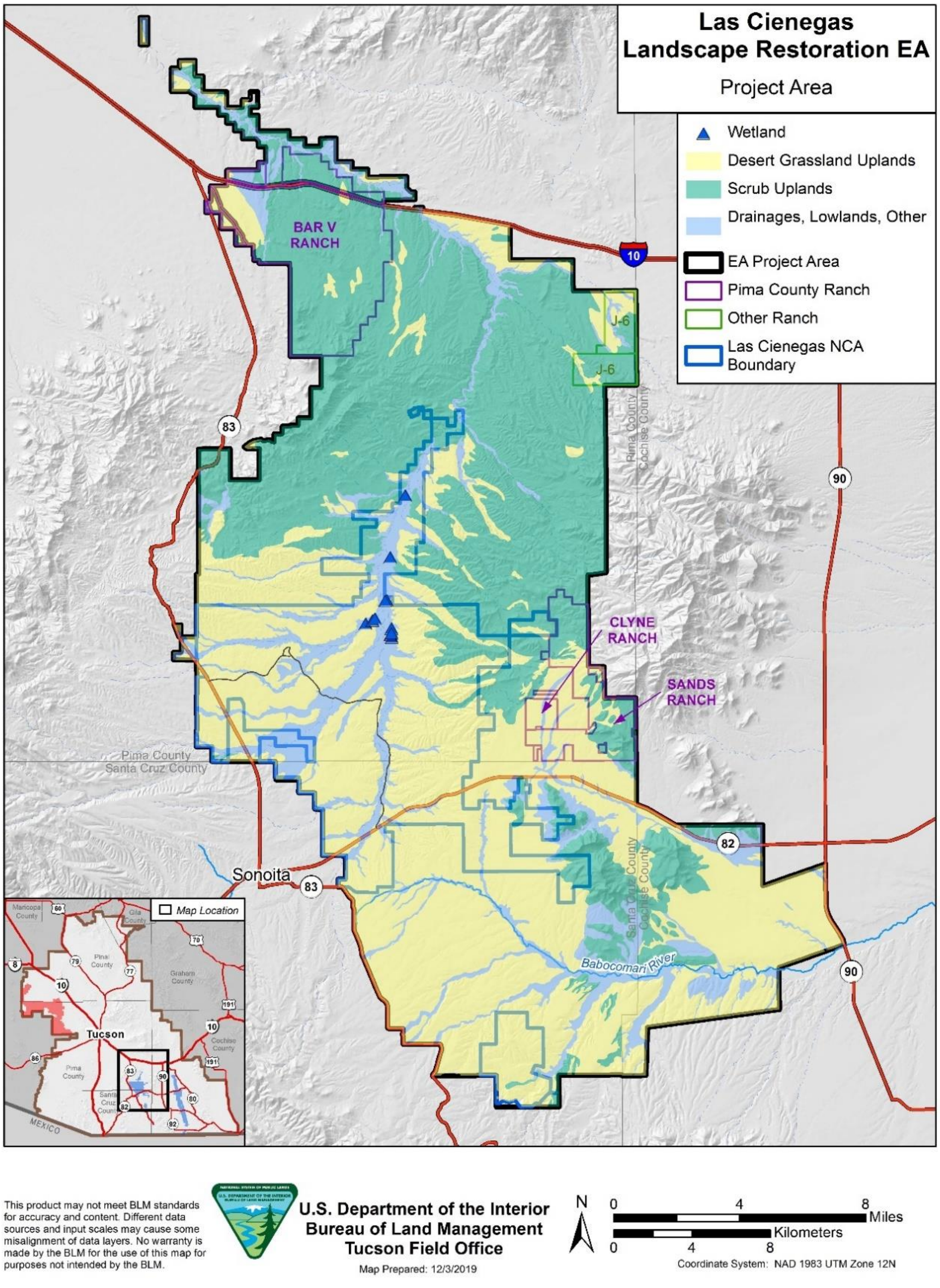

Figure 4. Vegetation types in the planning area.

Drainages, Lowlands, and Other Vegetation Communities

Cienegas are characterized by permanently saturated, highly organic, reducing soils and vegetation communities dominated by low-statured herbaceous hydrophytes (water-loving plants), with occasional patches of trees. In shallow water, typical species include those of the *Carex*, *Juncus*, and *Schoenoplectus* genera. Dense stands of sedges and charophytes fill shallow, braided channels between pools, while deeper, narrow, vertical-walled channels may be heavily vegetated with *Rorippa nasturtium-aquaticum, Ludwigia natans,* and other macrophytes. In adjacent deeper waters, vegetation is limited to low, shallow-rooted, semiaquatic sedges such as *Eleocharis* spp., *Juncus* spp., *Carex* spp., a few grasses, and more rarely, cattails (*Typha* spp.). Forbs include watercress (*Rorippa nasturtium-aquaticum*), whorled pennywort (*Hydrocotyle verticillata*), and creeping primrose-willow (*Ludwigia repens*), which can be rooted in patches of gravel below the organic root zone in pool bottoms. Few trees and shrubs may be present but may include Goodding's willow (*Salix gooddingii*), Fremont cottonwood (*Populus fremontii*), Arizona ash (*Fraxinus velutina*), and buttonbush (*Cephalanthus occidentalis*). Trees are scarce, limited to Goodding's willow (*Salix gooddingii*), coyote willow (*Salix exigua*), and swamp willow (*Salix lasiolepis*)*,* which can tolerate saturated soils (NatureServe 2018).

Cienegas are perpetuated by permanent, scarcely fluctuating sources of water, yet are rarely subject to harsh winter conditions. They are close enough to headwaters that the probability of scouring from flood is minimal. The system is controlled by a permanently saturated condition, which precludes colonization by any but specialized organisms. Soils contain thick deposits of organic sediments. Pools often have vertical walls of organic sediments and undercuts below root systems. Submerged macrophytes are commonly rooted in local, gravelly substrates.

The channel passing through cienega stream segments tend to be broad and indistinct with centrally located trench pools. A state and transition model for sites that have cienega wetland expression versus lotic riparian was developed specific to the Las Cienegas NCA in 2008 (see Bodner and Simms 2008). Drivers that lead to and maintain cienega habitat include fire, beaver activity, and site stability that prevents channel incision. Without suppression of trees (e.g., Goodding's willow), cienegas can revert to wooded swamp. Open water and plant diversity are maintained by disturbance in the form of flooding in Cienega Creek, and fire or grazing in cienegas situated within loamy bottom grasslands on floodplains.

Locations of cienegas were inventoried by Salywon and Tiller (DBG 2016). Four cienegas were restored in 2013 and vegetation established. Open water in cienegas with a perennial groundwater source have been identified. Reestablishing and/or maintaining this characteristic which supports federally listed plants, fish, amphibians, and aquatic reptiles is key to their conservation. Cienega habitat is highly variable as to its composition of dense marshland and open water and is usually encountered as a gradient.

Immediate surroundings of cienegas often are rendered saline through capillarity and evapotranspiration. As such, halophytes such as salt grass (*Distichlis spicata*)*,* yerba mansa (*Anemopsis californica*), and numerous species of Chenopodiaceae and Compositae live along the salt-rich borders of these riparian marshlands. Extensive stands of sacaton (*Sporobolus airoides*) also are common on adjacent flatlands. Upslope, and where soil aeration and salinities allow, broad-leaved lotic woodlands often develop. Typical riparian species of the region (such as seep willow [*Baccharis salicifolia*], Fremont cottonwood [*Populus fremontii*], Arizona sycamore [*Platanus wrightii*]*,* Arizona ash [*Fraxinus pennsylvanicus* var. *velutina*]*,* and walnut [*Juglans major*]) border such saturated areas, replaced in more xeric places by mesquite (*Prosopis velutina* and *P. glandulosa*) (Hendrickson and Minckley 1984).

Sacaton riparian grasslands are dominated by big sacaton (*Sporobolus wrightii*) and historically occupied millions of acres in the desert Southwest. While these grasslands now occupy less than 5% of their original distribution, the upper Cienega Creek watershed is known to harbor extensive stands of big sacaton habitat (Tiller et al. 2012b). Causes of decline include historical downcutting of rivers and consequent reductions in the overbank flow, dropping water tables from groundwater and stream diversion, sheet erosion, overgrazing, and shrub encroachment (Tiller et al. 2012b).

Mesquite bosque vegetation communities occur along riparian corridors along perennial and intermittent streams in the desert Southwest. Dominant trees include mesquites (*Prosopis* spp.), such as velvet mesquite. Shrub dominants include seep willow (*Baccharis salicifolia*), net-leaf hackberry (*Celtis reticulata*), and velvet ash (*Fraxinus velutina*). Woody vegetation is relatively dense, especially when compared with drier washes. Groundwater is essential to this community, and mesquites especially are dependent on the annual rise in the water table for growth and reproduction (NatureServe 2019).

Broad-leaved deciduous riparian communities occur along stream channels. The species composition may vary but include Fremont cottonwood, Goodding's willow (*Salix gooddingii*), net-leaf hackberry (*Celtis reticulata*), velvet ash (*Fraxinus velutina*), false indigo (*Amorpha fruiticosa*), Mexican elderberry (*Sambucus caerulea var mexicana*), Arizona black walnut (*Juglans major*), and yew willow (*Salix taxifolia*). Bordering broadleaf deciduous tree communities in more xeric places on upper banks or floodplains are sacaton grasslands and mesquite bosques. Tree diversity is low, but age class and structural diversity are high. Surface and subsurface hydrology are essential to this community, and groundwater pumping, damming, and diversions have been cited as threats (Stromberg 1993).

Historical Vegetation Conditions

A variety of anthropogenic and naturally occurring factors have altered historical vegetation communities in the planning area. A history of overgrazing, fire suppression, non-native plant infestations, and drought have contributed to a decrease in desired plant cover and an increase in invasive plant cover. More specifically, the encroachment of velvet mesquite and introduction of Lehmann lovegrass have acted to shift the extent and composition of historical climax communities away from desired future conditions as defined in the Las Cienegas RMP (BLM 2003; Petrakis et al. 2019; Tiller et al. 2012b).

Pantano Wash (Spanish for swamp) and its largest tributary, Cienega Creek, was likely the most extensive cienega system in the Rillito basin. Only small remnants persist today (Hendrickson and Minckley 1984). These remnants are located both on the Pima County Cienega Creek Natural Preserve and Las Cienegas NCA. Cienega Creek itself probably took its name from Ciénega de Los Pimas. In historic time, the area had been described as having abundant springs, which furnished a large volume of water, abundant grass, and a valley "quite boggy in the middle," a succession of meadows thickly covered with sacaton and salt grass where mesquite grew only in gulches (Hendrickson and Minckley 1984). In Arizona and New Mexico there are approximately 127 cienegas. Fewer than half (44%) of known ciénegas in Arizona are functional or restorable, while 56% have no potential for restoration or are dead from a lack of groundwater (Minckley and Brunelle 2007). The degradation of cienega wetlands resulted from activities associated with purposeful draining and channelization to reduce the threat of malaria or for agriculture, the removal of beaver from regional streams, development of wagon trails and train tracks, extensive wood cutting for homes and mines, intensive grazing on watersheds and within riparian zones and wetlands that led to down-cutting of river channels with cienegas (Hastings and Turner 1965, Dobyns 1981, Bahre 1992, Minckley et al. 2013). Factors that reduce stream flow and surface water needed to maintain cienega vegetation in southern Arizona include groundwater overdraft and climate change with some additional loss from changes in the vegetation community (Leenhouts et al. 2006). These factors are at play in the Cienega Creek basin (PAG 2014). Over the past 130 years, an estimated one-third of historical grassland in the region in and surrounding the Las Cienegas NCA have been lost to shrub conversion, and half of what remains is shrub-encroached (BLM 2010; van Leeuwen et al. 2012). Previous vegetation treatments covering approximately 19,500 acres have occurred in the planning area, and monitoring within the Cienega Creek watershed has shown a decrease in shrub cover as a result of previous vegetation treatments (Cienega Watershed Partnership 2018). The historical condition of Cienega Creek is described in depth in Hendrickson and Minckley (1984).

Since 2007, the BLM has been using a suite of vegetation treatments with an adaptive management framework to assess the effectiveness of vegetation treatments at reducing mesquite cover in the planning area, while evaluating the overall response of grassland vegetation and soil substrates (van Leeuwen et al. 2012; Tiller et al. 2012a). Within the Las Cienegas NCA, mechanical treatments (mastication and grubbing), chemical treatments (stump and foliar spray), and prescribed fire have been used alone and in combination to reduce the cover of mesquite, bulrush, and cattails on approximately 19,500 acres through 2022 (BLM GIS 2022). The most effective vegetation treatments in the Las

Cienegas NCA were found to be grubbing (removing mesquite by the roots with a backhoe), masticating, and hand cutting and spraying (BLM 2018). Prescribed fire provides variable levels of mesquite reduction and had been the least effective vegetation treatment for mesquite reduction (Tiller et al. 2012a).

Some isolated cienegas have been restored and vegetation treated to maintain open water. Treatment methods include hand cutting and employing a weed eater designed specifically for aquatic applications to remove invasive species that choke open water (for example, bulrush, cattail, and riparian trees). These methods have resulted in the desired maintenance of open water and a diverse wetland plant community. In one case, authorized livestock were used in a targeted livestock grazing treatment to arrest the spread of Johnson grass in a wetland area undergoing vegetation conversion to the invasive plant.[4]

Along with mesquite, Lehmann lovegrass is an important invasive plant species; at least 358,300 acres of semidesert grassland in southern Arizona have been invaded since its introduction in 1932 (Anable et al. 1992). Monitoring within the Las Cienegas NCA has shown a significant increase in the spread of Lehmann lovegrass, particularly in the sandy loam ecological sites (Gori and Schussman 2005).

Coupled with plant invasions, wildfire is a significant source of vegetation disturbance in the planning area. Wildfire in the Cienega Creek watershed has increased dramatically, and approximately 50,000 acres burned in 2017, which is more than in all fires in the preceding decade (Cienega Watershed Partnership 2018). Wildfire also contributes to the spread of Lehmann lovegrass, which responds to severe fire by increasing dominance in mixed stands (Uchytil 1992). In contrast, fire suppression has allowed wetlands to develop thick, impenetrable stands of bulrush and cattail where cattle grazing has ceased.

Soil erosion from historical land use practices has affected vegetation communities within riparian areas, particularly sacaton grasslands, cottonwood-willow riparian areas, and mesquite bosques. Due in part to the reduction of perennial grass cover and the spread of wood plant species, soil erosion has been increasing, which has increased impacts on riparian vegetation. Soil erosion within streambeds creates incised channels that limit the spread of water; consequently, water available from recharge associated with flood events that augment base flow and raise groundwater elevations to adjacent vegetation communities is reduced. The southern bottomlands (areas below 4,600 feet) are particularly prone to soil erosion due to low plant or litter cover, or both, and past soil erosion projects have occurred primarily in these areas (Gori and Schussman 2005; Tiller et al. 2012a).

Within the Cienega Creek Valley, much of the watershed is in good to very good condition with respect to soil cover, grass density, and litter. Many of the dry washes that are tributaries to Cienega Creek are in exceptionally good condition while others are in very poor condition. Areas affected by accelerated erosion include Pump Canyon, Wood Canyon, drying segments of Cienega Creek, and moonscapes on terraces next to Cienega Creek.[5]

3.2.2 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, there would be no expanded methods used to treat and maintain tree- and shrub-invaded upland areas, or to maintain sacaton grasslands, mesquite bosques, wetlands, riparian areas, and areas invaded with noxious species so that those areas meet the vegetation and watershed objectives described in the Las Cienegas RMP and listed in Appendix A. Vegetation communities would continue to trend away from reference conditions. Erosion control projects would not be constructed, and soil erosion would continue to limit water availability to riparian vegetation communities and further contribute to movement away from reference conditions. Wetlands would also continue to fill with detritus from large quantities of bulrush and cattails that invade and choke open water over time.

[4] Jeff Simms, BLM, personal communication.
[5] Jeff Simms, BLM, personal communication.

Cumulative Impacts

The five watersheds overlapping the proposed action area (Table E-5) are the geographic scope of the analysis area for cumulative impacts; however, some of the cumulative impacts go beyond the watershed for cienega ecosystems and vegetation with regional implications.

Since cienega vegetative communities are greatly influenced by soil and water resources, see cumulative impacts under Soil and Water Resources, Sections 3.1.2 and 3.1.3. Vegetation and wetland restoration treatments have been implemented in the watershed, including seven erosion control and restoration projects completed between 1994 and 2015 on Pima County land in the Cienega Creek Natural Preserve as well as the approximately 19,500 acres of vegetation on the NCA since 2004. In addition, wildfires, current and historical livestock grazing, mining, railroads, and unpermitted woodcutting have contributed to altered vegetation communities. The Rosemont Copper Mine occurs within the vicinity of the project area and groundwater drawdown associated with mining activities would have the potential to permanently reduce the extent of riparian vegetation communities. Vegetation disturbance for restoration purposes has moved and would continue to move vegetation communities toward reference conditions. Should beaver be reintroduced into the Las Cienegas NCA, they would alter hydrology in riparian areas, resulting in increased water availability for vegetation and potentially expanding the extent of riparian vegetation communities.

Surface-disturbing activities, such as mining and unpermitted woodcutting, would be expected to contribute to moving existing vegetation communities away from reference conditions and increasing the cover of invasive plant communities, including the cover of invasive woody plants, such as mesquite, and herbaceous species, such as Lehmann lovegrass. A variety of impacts are associated with livestock grazing, depending on grazing intensity, which could prevent achieving desired conditions. For instance, grazing can spread Lehmann lovegrass or overgrazing could exacerbate impacts on vegetation. The continued suppression of fire and lack of vegetation thinning of cienegas would allow wetland vegetation to continue through ecological succession to a state where no open water may be present and the wetland may eventually fill in without disturbance from floods.

Cumulative impacts would also be expected from climate change. Climate change is expected to increase annual temperatures while decreasing winter precipitation and increasing the intensity of precipitation events (Garfin et al. 2013). Disturbances from climate change coupled with anthropogenic surface disturbance events, such as groundwater pumping, would contribute to shifting vegetation communities away from desired conditions.

3.2.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Issue 1: How would the proposed vegetation treatments and erosion control projects affect upland and riparian vegetation communities across different timescales?

Under the proposed action, the composition and cover of the existing vegetation community would be shifted toward the vegetation and watershed objectives described in the Las Cienegas RMP. Long-term (greater than 5 years) impacts of the proposed action would lead to vegetation communities that would support a reduced cover of woody plant species and an increased cover of perennial grass species. The increased grass cover would also lead to a decrease in bare ground.

Cienegas would be restored and maintained to a balance of open water and vegetation with a diverse plant community, including special status plants. Habitat suitability for aquatic species (such as plants, invertebrates, fish, and frogs) would improve in wetland environments. The replacement of native herbaceous vegetation by invasives such as Johnson grass or big leaf periwinkle (*Vinca major*) in wetlands and riparian areas would be arrested or reduced in key locations.

Erosion control and stream restoration treatments would increase areas available for establishment of the desired vegetation community over the long term by preventing headcuts, reducing stream grades, increasing floodplain connectivity, and capturing sediment.

Table E-2 shows the acres of each vegetation type that each erosion control and stream restoration treatment would potentially affect. The precise location, extent, and methods of treatments are not fully defined at the planning-level phase. Thus, a precise quantification of potential impacts is not feasible and impacts on vegetation are described primarily qualitatively. A quantitative analysis is provided where there is information of where treatments or projects would likely occur under the proposed action.

Currently proposed erosion control and stream restoration projects would improve approximately 864 acres of vegetation including 36 acres of riparian habitat as shown in Table E-2.

The proposed action includes a maximum of 1,394 acres per year of erosion control treatments (Table 8) that would impact less than 1% of the planning area annually. The impacts to vegetation from prescribed fire and herbicide treatments, as described above would occur across that area.

Issue 2: What would be the impact of the proposed vegetation treatments on non-target native vegetation?

Broadcast application of tebuthiuron could have herbicidal effects to non-target native upland plant species within a treatment unit. Potential impacts to non-target plants include mortality, reduced productivity, and abnormal growth (BLM 2007, 4-47). For example, when applied at rates of 1.8 and 3.6 lb a.i./acre (2 and 4 kg a.i./ha) to treat juniper in sagebrush-bunchgrass community in Oregon, tebuthiuron appeared to damage non-target forbs and perennial grasses (Britton and Sneva 1981). However, that application rate is over five times more than what is proposed in this EA. Gibbens et al. 1987 found decreases in native perennial forb density but increases in native annual forb density after a treatment of 0.36 lb a.i./acre (0.4 kg a.i./ha) of tebuthiuron pellets.

Broadcast tebuthiuron treatments could impact offsite non-target native plants through drift, runoff, or accidental spills (BLM 2007, 4-47), including riparian vegetation where broadcast tebuthiuron treatment is not proposed. Broadcast tebuthiuron treatments would use solid pelletized product, which has less risk of drift compared to liquid herbicide. Risk to off-site plants from surface runoff is influenced by precipitation rate, soil type, and application area (BLM 2007, 4-55). The fall through early spring application timing mitigates the risk of runoff because winter storms in the region are frontal and gentle in nature, producing less runoff than monsoon storms. In addition, application buffers, BMPs (Appendix B), BLM herbicide handling guidelines, and low application rates proposed in this EA (maximum application rate of Spike® 20P in areas with less than 20 inches of precipitation is 5 lb a.i./acre verses less than 0.5 lb a.i./acre proposed in this EA) would greatly reduce the risk of impacts to offsite non-target native plants. Finally, actual treatment unit development (Section 2.1.1) would consider site-specific characteristics and mitigation measures to reduce or eliminate impacts to non-target vegetation from broadcast application of tebuthiuron.

Herbicide spot treatments would have little to no impacts to non-target native vegetation because only the target species would be treated with herbicide. There is risk of overspray getting on non-target vegetation next to the target species. However, this would be mitigated by proper handling of herbicides and measures to reduce drift such as, not spraying during high winds, lowering spray nozzle closer to target species, and use of proper nozzle.

Prescribed fire would directly remove all vegetation by burning. Vegetation communities in the planning area are adapted to fire and over time vegetation would recover. Pre-settlement fire frequency of semidesert grassland in southeastern Arizona could have been around 4-9 years (Kaib et al. 1996). Ahlstrand 1982, found that perennial grasses in Chihuahuan desertscrub took 6-7 years to increase in cover and fully recover after burning, and hypothesizes that burning every 10-15 years would maintain reduced shrub cover in this community. Upland plant communities may experience a decrease in perennial grass cover and an increase in forb cover for several years after burning as perennial grasses recover (Kaib et al. 1996, Ladwig et al. 2014) with potential for a long-term negative impact on black gramma grass (Killgore et al. 2009, Ladwig et al 2014). Though upland vegetation communities would incur short-term (1-6 years) impacts of vegetation loss, perennial grasses would only experience top kill and resprout from the root crown (Ahlstrand 1982, Kaib et al. 1996, Killgore et al. 2009, Ladwig et al 2014). In addition, the required minimum two years of deferred grazing in prescribed burn units would aid in native perennial grass regeneration.

Erosion control and stream restoration treatments would aid in seeding treatment success and reduce soil erosion by trapping water and sediment. Impacts to non-target vegetation include crushing, trampling, or direct removal of plants due to temporary access routes and use of heavy equipment. However, these effects would occur once, be short-lived, and be mitigated by BMPs (Appendix B) and post-treatment remediation (i.e., mulching, reseeding) described in the Proposed Action.

Targeted grazing in wetlands could impact non-target native plants through trampling and direct consumption by livestock. Careful planning of targeted livestock treatments would mitigate adverse impact to non-target native vegetation, as cattle would be promptly removed after treatment objectives are achieved. Temporary or permanent fencing would control the extent of grazing on non-target plants and rare plants such as, Huachuca water umbel, Arizona eryngo, and Canelo Hills ladies' tresses, would be excluded from any target grazing treatments.

While most of the vegetation within the project area would be available for treatment (Table 3), the actual acres of each restoration treatment would be much smaller and would occur over several days to weeks (see Section 2.1.6). As such, impacts on non-target native vegetation would be limited. Further, incorporating best management practices (Appendix B) would minimize or avoid adverse impacts on vegetation. These measures would minimize adverse effects by minimizing surface disturbance, especially in sensitive areas; mitigating herbicidal effects to non-target plants; preventing invasive plant introduction during treatments; and monitoring and treating invasive plants following treatments.

Issue 3: How would the proposed treatments increase the spread of Lehmann lovegrass?

Monitoring data has shown that Lehmann lovegrass exists in many places throughout the project area. Given the difficulty in eradicating this species, restoration treatments would not likely decrease the cover of Lehmann lovegrass over the long term. There may be some potential to increase the spread of Lehmann lovegrass in the short term due to surface disturbance from mechanical treatments and prescribed fire. Erosion control treatments would result in short-term impacts, including vegetation disturbance from the harvesting of rock and operation of heavy equipment, increasing the potential for Lehmann lovegrass to spread.

While most of the vegetation within the project area would be available for treatment (Table 3), the actual acres of each restoration treatment would be much smaller and would occur over several days to weeks. As such, the likelihood to increase the spread of Lehmann lovegrass would be limited. While Lehmann lovegrass would not likely decrease, this would be offset by the long-term improvements in vegetation communities resulting from the restoration treatments. Further, BMPs (listed below in Issue 4) would minimize adverse effects.

Issue 4: How would the proposed treatments affect wetland plant communities and the Huachuca water umbel?

Proposed treatments would restore and maintain cienegas (see Vegetation Issue 1). Further, treatments would improve habitat suitability for aquatic species, including aquatic plants such as the Huachuca water umbel. The Huachuca water umbel in particular is threatened by aquatic habitat degradation and competition with nonnative, invasive species (USFWS 2017). Proposed wetland vegetation treatments would improve vegetation composition and wetland function and reduce the threats to this species once treatment objectives are met.

While most wetlands within the project area would be available for treatment (Table 3), the actual acres of each restoration treatment would be much smaller and would occur over several days to weeks. As such, the short-term degradation of wetland habitats during treatments through, for example, vegetation removal or surface disturbance would be limited. All proposed treatments that may affect the Huachuca water umbel have conservation actions that would minimize the effects on the species and may actually benefit the umbel and its habitat; therefore, the proposed action would only have localized and short-term adverse effects to the species.

Best management practices that would minimize adverse effects or surface disturbance are listed below.

- **(Vegetation) VG-03** Weed-free straw and mulch may be utilized during rehabilitation and other activities (e.g., revegetation, soil stabilization, and erosion control).
- **VG-05** Reseed or plant (disturbed areas and/or treatment areas), where appropriate, with desirable vegetation when the native plant community cannot recover and occupy the site sufficiently.
- **VG-06** When reseeding, native or sterile species for revegetation and restoration projects will be used to compete with invasive species until desired vegetation establishes.
- **(Noxious Weeds) NW-01** All equipment (e.g., contractor- and BLM-owned) utilized during and for treatments will be cleaned to remove dirt and debris to minimize the potential of transporting noxious weed seeds or plant parts, prior to arriving on-site for treatment implementation.
- **(Herbicide Treatment) HT-05** Herbicides utilized will take into account target vegetation, sensitive plant and animal species, as well as sensitive land features, such as water sources and soil characteristics.
- **HT-06** All herbicide applications will follow the stipulations outlined in the 2007 and 2016 update to the Western Vegetation PEIS (BLM 2007, 2016a) and associated Records of Decision.
- **(Soils) SO-01** Minimize or exclude herbicide treatments that have high mobility and in areas where herbicide runoff is likely, such as during periods of intense rainfall, saturated and impermeable soils, on steep slopes, and paved surfaces.
- **SO-02** Granular herbicides will not be applied on slopes of more than 15% where there is the potential of runoff carrying granules into nontarget areas.
- **SO-03** Equipment (e.g., heavy equipment, vehicles, and utility terrain vehicles) will not be used when soils are seasonally saturated or following heavy precipitation to minimize soil disturbance (e.g., rutting and compaction).
- **SO-04** Soil characteristics and topography will be considered in vegetation treatment development to reduce the potential of soil erosion.
- **(Temporary Access) TA-03** No new permanent roads will be established; all access routes to vegetation treatment units that develop two tracks may be signed with administrative access only during project implementation. (This may reduce the spread of invasive species.)
- **TA-05** Upon completion of the vegetation treatment, all temporary access routes will be evaluated for rehabilitation and closed to further traffic.
- **GM-02** Following a vegetation treatment, cattle would be excluded from the treatment unit for a minimum of two growing seasons (July-December) or until resource conditions are met as outlined in this EA and the Las Cienegas RMP to allow for perennial grasses to grow and drop seed before cattle enter the unit. Post-treatment monitoring will assist in determining the timing of the reintroduction of deferred livestock. Reintroduction timing will be based on favorable vegetation regrowth rather than on a predetermined duration.

3.2.3.1 Cumulative Impacts

Cumulative impacts on vegetation under the proposed action would be similar to those described under the no action alternative, but restoration actions would have an increased capability to return vegetation communities to reference conditions. Density, composition, and structure of cienegas would create a balance of open water and diversity of plant community, including special status plant species. Habitat suitability for aquatic species (such as invertebrates, fish, and frogs) would improve in wetland environments. The replacement of herbaceous marsh vegetation in cienegas and understory vegetation in riparian areas would likely be arrested or reduced in key locations.

Under the proposed action, vegetation management would contribute to the integrity of upland areas and the reduction of target woody and herbaceous species, and it would maintain or increase the amount of vegetation suitable for wildlife habitat. Erosion impacts would also be reduced, resulting in an increase in available water to riparian vegetation. Cumulative impacts from climate change would be the same as those under the no action alternative.

Wetlands on a regional scale (Arizona and New Mexico) would benefit from the cumulative beneficial effects to the maintenance or improvement of ecological integrity and function in the Cienega Creek basin and allow for the continued and future recovery of federally listed wetland plants. Together with other ongoing and planned restoration efforts in the basin and the region, along with those recovery efforts for listed plants across their individual ranges, the proposed action would have a large beneficial cumulative impact over time and at a regional scale.

3.3 Wildlife and Migratory Birds, Including Special Status Species

- Issue 1: How would heavy equipment, chain saw noise, and associated human activity affect, migratory birds, general wildlife, and threatened, endangered, and sensitive species behavior, health, and distribution?
- Issue 2: How would the removal of vegetation, including upland, wetland and riparian, affect habitat (breeding habitat, nesting habitat, hiding cover, and thermal cover) for migratory birds, general wildlife species, and specifically for threatened, endangered, and sensitive species?
- Issue 3: What would be the impact from the proposed vegetation management and treatments and erosion control projects on wetland plant communities, aquatic habitat, aquatic (fish, amphibians and aquatic reptiles) species including threatened and endangered species, and critical habitats?
- Issue 4: How would upland treatments change sediment load and water quality in Cienega Creek and Empire Gulch? (This issue is addressed by Issues 1 and 2 in Section 3.1, Soil and Water resources.)

3.3.1 Affected Environment

The planning area provides habitat for over 300 species of migratory birds, 60 native mammals, and approximately 50 species of fish, reptiles, and amphibians (see Appendix D, Table D-1, List of Wildlife Species with Potential to Occur in the Las Cienegas Landscape Restoration EA Project Area). In addition, 13 federally threatened or endangered wildlife and three plants protected by the Endangered Species Act (ESA) occur or have potential to occur in the planning area. Designated or proposed critical habitat for ESA-listed species occurs for six species in the planning area (Appendix D, Table D-2, Federally Protected Species and Critical Habitat in the Project Area; USFWS 2019). Due to limited distribution, especially in the arid Arizona landscapes, riparian, cienega, and aquatic habitats provide the greatest diversity and value to wildlife, including aquatic species, migratory birds, and threatened and endangered species. The Las Cienegas NCA has five of the rarest habitat types in the southwest United States: cienegas, cottonwood-willow riparian areas, sacaton grasslands, mesquite bosques, and semidesert grasslands, making it highly valuable for a diversity of wildlife.

There are approximately 1,457 acres of riparian habitat, 98 acres of lakes/ponds, 38 acres of wetlands/cienegas, and 1,599 miles of perennial, intermittent, or ephemeral streams in the NCA that could provide habitat for a variety of native fish, frogs, and other aquatic-dependent plant and wildlife species (see Table E-7, Section 3.1, Soil and Water Resources and Section 3.2, Vegetation). There are seven major springs, 14 wildlife ponds, and over 40 wetland sites in the NCA (Desert Botanical Gardens inventoried 44 wetlands covering 38 acres on Las Cienegas NCA south of Highway 82; DBG 2016), but no National Wetland Inventory (NWI) wetlands (BLM GIS 2019).

Cienega Creek is the major biogeophysical feature within the NCA. The diversity of vegetation types within riparian and wetland areas along the creek contributes to high-value aquatic habitats. Cienega Creek maintains perennial surface flow in two reaches: from its headwaters to Gardner Canyon and from its confluence with Cold Spring to just downstream of Fresno Canyon and from the confluence with Mescal Wash to just downstream of the Colossal Cave Road crossing in Vail, Arizona. Other reaches of perennial water occur in tributaries to Cienega Creek and include Empire Spring, lower Empire Gulch, and Mattie Canyon. Perennial flow in Cienega Creek and tributaries fluctuates from year to year from a maximum of 7.8 miles to a minimum 4.8 miles (BLM Annual Cienega Creek Wet-Dry database).

Bullfrogs occupied the upper portion of the creek until 2015 when suppression efforts finally eliminated them from the watershed. Bullfrogs still threaten the area as they migrate from the Babocomari River drainage each summer during the monsoon season. There are no nonnative fishes and Cienega Creek continues to support a diverse native aquatic vertebrate community including Gila topminnow, Gila chub, longfin dace, Chiricahua leopard frog, lowland leopard frog, Sonora mud turtles, and northern Mexican gartersnake.

The entire assemblage of native fishes and native leopard frogs of the Gila River system are all biologically imperiled to various degrees and are found on federal, state, and BLM sensitive species lists (BLM 2011). Populations of aquatic species have been established at various wildlife and wetland ponds in the Las Cienegas NCA. A number of new populations have been established for the following species: Gila topminnow (9), Gila chub (1), desert pupfish (10), Chiricahua leopard frog (19), northern Mexican gartersnake (at least 3, others not inventoried), Huachuca water umbel (4). Huachuca water umbel populations exist on Cienega Creek, where the species is spreading throughout the stream system and increasing (BLM 2019a, BLM 2011). Self-sustaining Chiricahua leopard frog populations occur in Cienega Creek, Empire Gulch, Mattie Canyon, and off-channel ponds as well as four restored wetlands and 11 other locations, including newly created wildlife ponds. Gila chub are present in Cienega Creek and Mattie Canyon; an additional population has been added to Spring Water Wetland, and establishment is planned in the near future in the Las Cienegas NCA. Desert pupfish now occur in three wetland ponds and seven wildlife ponds. Two of the populations are located on the BLM portion of Appleton-Whittell Audubon Research Ranch and two more on private land (BLM 2019). Gila topminnow populations occur at Cienega Creek. Chiricahua leopard frogs and northern Mexican gartersnakes occupy perennial stock tanks, through emigration from source populations to these tanks. Other populations of lowland and Chiricahua leopard frog exist on Pima County lands (personal communication Karen Simms, BLM Parks and Natural Resources Division).

Cienegas and associated riparian areas support a variety of rare, federally listed or otherwise imperiled species (Minkley et al. 2013). In Arizona, wetland environments occupy about 2% of the land area and are critical habitat for at least 19% of the threatened, candidate, or endangered species within the state. Cienegas and riparian corridors, by providing different habitat in otherwise arid regions, may increase regional biodiversity by 50% or more (Sabo et al. 2005). Cienegas have a very high value for avian diversity, even relative to other riparian communities. Skagen et al. (1998) found more species of migrating birds in southeast Arizona use isolated cienegas than sites along a continuous riparian corridor. A study of riparian areas around the Huachuca Mountains in Arizona found several native bird species were restricted to or reached their highest densities in cienegas with cottonwood trees in a landscape dominated by grassland (Strong and Bock 1990).

Riparian habitat and wetlands are also important for a variety of migratory birds and two riparian-dependent ESA birds: western yellow-billed cuckoo and southwestern willow flycatcher. In addition, the planning area contains two important bird areas: the 7,723-acre Appleton-Whittell Research Ranch in the south and the 37,760-acre Las Cienegas NCA (Arizona Important Bird Areas Program 2011). Empire Gulch has documented nesting western yellow-billed cuckoos within the Las Cienegas NCA (Arizona Important Bird Areas Program 2011).

ESA critical habitat for northern Mexican gartersnake, jaguar, southwestern willow flycatcher, yellow-billed cuckoo, Chiricahua leopard frog, and Gila chub occurs in the planning area (Table E-8). This critical habitat is mostly centered around aquatic and riparian habitats.

Although riparian and aquatic habitats provide higher wildlife value, desert uplands and scrub uplands support numerous wildlife species, including grassland birds, rodents, jackrabbits, bats, ungulates, mountain lions, coyotes, and foxes. Trees and shrubs provide for nesting raptors and other resident breeding birds.

3.3.2 Impacts from the No Action Alternative

Direct and Indirect Impacts

As described above, the project area has five of the rarest habitat types in the Southwest, making it highly important for both terrestrial and aquatic wildlife and migratory birds. Healthy grasslands, wetlands, and riparian habitats are limited on the landscape and are experiencing degradation from human and natural causes (see Section 3.1: Soil and Water Resources and Section 3.2: Vegetation).

The region is used for many purposes, including heavy recreation (which may cause inadvertent spread of invasive or noxious weed species by seed), livestock grazing, habitat preservation and restoration, endangered species recovery, collection of dead and down trees (permits required if used for personal use outside of use for campfires), mining, and ex-urban development. Other activities with the potential to affect wildlife and habitat include OHV use, wildfires, mesquite encroachment, climate change, and the spread of invasive species (Lehmann and Boer lovegrasses, Johnson grass, Bermuda grass, and bulrush and cattails in wetland habitats) (Arizona Important Bird Areas Program 2011; Cienega Watershed Partnership 2018).

Under the no action alternative, impacts from heavy equipment, chain saw use and associated human activity would not occur, because the BLM would not implement proposed vegetation treatments or erosion control projects. Previous vegetation treatment areas would not be maintained; therefore, there would be no direct impacts on wildlife or migratory bird species from new activities in these areas. However, lack of vegetation management and treatments in these areas may have impacts to wildlife or migratory birds through further encroachment of invasive or noxious weed species, erosion of soils, or spread of unnatural fire. Wildlife habitat that is not suitable for occupation by federally listed aquatic species would remain unsuitable for the species if vegetation is not managed in cienega habitats.

The agency could, however, implement vegetation treatments that are identified under existing NEPA documentation (EA# 420-2006-19, EA#: DOI-BLM-AZ-G020-0021, and EA# DOI-BLM-AZ-G020-2011-0028), and ongoing impacts on wildlife and migratory birds from those vegetation treatments would continue, as described in the associated EAs.

Current management would indirectly result in continuing degradation of important wildlife habitats as a result of erosion, encroachment of woody species, encroachment of herbaceous species in wetlands, spread of invasive species. Recent ecological reports have documented that collaboration and restoration efforts have been successful in the Las Cienegas NCA in decreasing woody species encroachment, controlling invasive species, and improving grassland and riparian habitats (Caves et al. 2013; Cienega Watershed Partnership 2018; Tiller et al. 2012a; Tiller et al. 2013; Bodner and Simms 2008; Gori and Schussman 2005; BLM 2015). Without active management and cross-jurisdictional coordination to implement vegetation treatments and erosion control projects, important wildlife habitats, especially cienegas and riparian and desert grassland ecosystems, would be less resilient to adverse impacts and would continue to decrease in the region.

Cumulative Impacts

The five watersheds overlapping the proposed action area (Table E-5) are the geographic scope of the analysis area for cumulative impacts; however, some of the cumulative impacts go beyond the watershed for cienega ecosystems and vegetation with regional implications.

Since cienega animal communities are greatly influenced by soil and water resources and cienega vegetative communities, see cumulative impacts under Sections 3.1.2, 3.1.3, 3.2.2, and 3.2.3. Habitat-altering activities in and near the planning area include livestock grazing; residential development; mining; wood cutting; off-highway motorized recreational vehicle use; groundwater pumping on private lands, such as vineyards; potential for beaver reintroduction; various vegetation and wetland treatments and fire management projects designed to restore habitat integrity to reference conditions (e.g., seven erosion control and restoration projects completed between 1994 and 2015 on Pima County land in the Cienega Creek Natural Preserve; removal of mesquite in mesquite-invaded grasslands; removal of Johnson grass and bigleaf periwinkle in wetlands and riparian areas); and new invasive species released by recreation and other activities. Some actions would result in improved ecological function; however, cumulatively over time, many surface disturbance activities in and near the planning area may serve to fragment habitat and reduce habitat quality for native wildlife species, including special status species. The effects of climate change are anticipated to increase the scale and pace of effects on wildlife habitats, especially in high-value riparian and aquatic habitats in the desert landscape, in combination with habitat-altering activities.

3.3.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Exact locations and methods of vegetation or erosion control activities are not fully defined at the planning-level phase. Thus, a precise quantification of potential impacts is not feasible, and impacts on migratory birds and wildlife are described primarily qualitatively. A quantitative analysis is provided where there is information of where treatments or projects would likely occur under the proposed action. Impacts on migratory birds and wildlife are based primarily on changes to occupied and potential habitat where proposed activities are likely to have adverse, short-term effects; but over the long term, improvements to habitat quality would benefit wildlife associated with such habitats. Inclusion of BMPs (Appendix B) and conservation measures, described below and in the biological assessment (BA), would avoid or reduce potential adverse impacts on migratory birds, wildlife, including special status species. It is assumed that further environmental review, as needed, at the design and project level would evaluate and mitigate site-specific potential impacts on wildlife, special status species, migratory birds, and aquatic species.

Potential impacts on terrestrial wildlife and migratory birds, including special status species, are detailed in Table E-9; potential impacts on aquatic species, including special status species, are described in Table E-10.

Issues 1 and 2: How would heavy equipment, chain saw noise, and associated human activity affect migratory birds, general wildlife and threatened, endangered, and sensitive species health, behavior, and distribution? How would the removal of vegetation, including upland, wetland or riparian, affect habitat (breeding habitat, nesting habitat, hiding cover, and thermal cover) for migratory birds, general wildlife species, and specifically for threatened, endangered, and sensitive species?

The project is cross-jurisdictional to improve habitat conditions on a landscape scale and to address wildlife movement corridors. The purpose of this project also includes treating existing and future potential soil erosion areas with erosion control structures. Activities related to these efforts could cause short-term, localized impacts on wildlife and their habitats. These could include disturbance and displacement from surface disturbance activities (mechanical and manual treatments), heavy equipment and chain saw noise, prescribed fire, chemical treatments, erosion control projects, and associated human presence. Impacts would be more pronounced during sensitive periods, such as nesting, denning, spawning, or hibernating, where activities could cause reduced reproductive success or potential harm or mortality to wildlife, including special status species and migratory birds. Also, short-term effects would be proportionally greater in limited, high-value areas like cienegas and riparian habitat than in widespread scrub uplands or general grassland communities (see Section 3.2: Vegetation).

Under the proposed action, short-term impacts, such as displacement, to migratory birds, general wildlife species, and threatened, endangered, and sensitive species may occur during the initial vegetation treatments. However, vegetation treatment schedules would be managed by BLM to avoid disturbance during breeding and nesting periods. Long-term impacts would include habitat improvement, which would result in reduction of impacts to migratory birds and wildlife species.

Issue 3: What would be the impact from the proposed vegetation management and treatments and erosion control projects on riparian and wetland plant communities, aquatic habitat, aquatic (fish, amphibians and aquatic reptiles) species, including threatened and endangered species, and critical habitats?

Of the activities described in Tables E-9 and E-10, mechanical, prescribed fire, and herbicide treatments (for both vegetation treatments and erosion control and stream restoration treatments) would have a higher potential to affect aquatic species and habitat, including aquatic special status species and critical habitat. Use of heavy, mechanized equipment could trample and crush smaller wildlife such as amphibians. Fire can be lethal to wildlife that are not able to flee the area and contact with certain herbicides can have deleterious effects on certain species.

Broadscale application of prescribed fire and herbicides has the potential to remove the majority of existing vegetation, which would increase runoff and transport soil, ash, debris, and/or herbicides to surface water, thereby affecting water quality and habitat conditions for aquatic wildlife, such as native fishes. Treatment scale would be adjusted to diminish these potential impacts. Changes in vegetation composition resulting from these treatments could also affect water availability because different plants use different amounts of water, and thus could lead to changes in habitat availability for aquatic species over the long term. In addition to vegetation removal, mechanical treatments would disturb and compact soil, thereby decreasing soil infiltration capacity and increasing erosion and runoff to aquatic habitats. Compaction can be reduced using equipment with low ground pressure tires and tread. Leaving behind vegetation or viable root systems can resolve compaction through loosening of soil as plants regrow following treatment.

An in-depth discussion of chemical treatment effects on wildlife is provided in the Vegetation Treatments using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (BLM 2007, pp. 4-101 to 4-118) and the 2016 Final PEIS for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on BLM Lands in 17 Western States (BLM 2016a, pp. 4-54 to 4-60).

The use of livestock to control crowding vegetation in restored wetlands and artificial ponds could degrade riparian areas and affect streambank stability around the ponds, which would affect riparian-dependent wildlife, aquatic, and fish species. Changes in streamside vegetation (around restored wetlands and artificial ponds) could affect water temperature, while animal waste could elevate nutrient levels, thereby reducing water quality. In addition, trampling of amphibians and other aquatic organisms by cattle would result in a loss of eggs or direct mortality. Habitat alterations may improve habitat for some species but degrade it for others, although practices that promote habitat diversity generally improve wildlife habitat overall (Launchbaugh et al. 2006). Targeted grazing would be implemented as described in Section 2.1.4: Targeted Livestock Grazing in Wetlands, which would reduce impacts by optimizing efficacy and reducing the length and/or frequency of treatments. Over the long term, targeted grazing is expected to improve habitat by reducing cover of invasive species, such as Johnson grass (Simms 2019).

Treatments that take place within aquatic habitats would have the highest potential to result in direct impacts on aquatic species. For example, disruptive activities in aquatic environments (e.g., pulling aquatic vegetation or using an underwater weed eater) would have a moderate to high probability of affecting Huachuca water umbel and fish and amphibian eggs attached to vegetation. The probability would be lower for mobile wildlife such as Mexican gartersnake, Chiricahua leopard frog, Gila chub, desert pupfish, and Gila topminnow. Heavy equipment and human presence would have a moderate to high probability of disturbing Mexican gartersnake and Chiricahua leopard frog. Further, the use of heavy equipment in or near wetland and riparian habitat has the potential to injure or kill other wildlife such as snakes, turtles, and amphibians. Overall, while some individuals would be impacted in the short term, there would not be significant impacts at the local population level.

Treatments in surrounding habitats and uplands would mainly have indirect impacts on aquatic species through effects on habitat described above and in Table E-10. Potential treatment acres for vegetation treatments have not yet been identified, but initial potential erosion control projects have been designed and areas identified (see Section 2.1.4). Initial erosion control projects would improve approximately 2% of total aquatic habitats in the project area (Table E-11) and no more than 2% of critical habitat for any federally listed species in the project area (Table E-12). Future erosion control projects could be designed and implemented as needed; the areas of future projects are unknown but could feasibly overlap riparian habitats and threatened and endangered species critical habitats. Project mitigation would be devised and ESA compliance with the BO would occur for each treatment during planning and implementation. If a future vegetation treatment is unlikely to conform with the BO, the new project would require modification or additional consultation.

Over time, vegetation, erosion control, and stream restoration treatments would restore the vegetation community and indirectly benefit fish and wildlife by improving habitat conditions and availability. Vegetation initially removed by the treatment methods would come back as healthy, diverse, and resilient communities (with no or few invasive species such as tamarisk). Wetland function would be restored, water quality would be improved (from reduced erosion), and riparian habitat function would improve through increased overbank flooding with shallow aquifer recharge, improved surface flow permanence, increased tree generation along point bars, increased nursery habitat inside meanders, and other riparian system function improvements (Simpson 2007; Kline and Cahoon 2010; Fogg et al. 2012).

The use of prescribed fire to set back succession of emergent marshlands and mimic the natural disturbance regime would help increase endemic organisms that are adapted to large flood events, such as marsh-dependent birds (Conway et al. 2010). Achieving long-term habitat management objectives would increase the extent and condition of riparian areas and wetlands, which are important habitats for many aquatic species, including migratory bird, fish, and amphibian species. Increased riparian vegetation would improve habitat for southwestern native fish species, many of which are less tolerant to increased stream temperature than previously thought (Carveth et al. 2006). Aquatic habitat choked with wetland vegetation would become suitable for an array of Federally listed aquatic species, which would aid in their recovery.

Following BMPs (WR-01 to WR-04, and WL-01 to WL-05) would minimize impacts on aquatic species and their habitats, including special status species and critical habitats. The treatment methods chosen would balance the best method(s) (integrated vegetation management) for invasive vegetation control with those with the fewest effects on a variety of species. For example, manual and mechanical treatments can be combined to lessen effects on special status species, while herbicides could be used in combination with or following other types of treatments. Because vegetation removal activity during breeding bird, fish, amphibian, and reptile periods cannot be avoided, a biological monitor would be on-site to ensure that threatened, endangered, and sensitive species injury or mortality is minimized and the duration of work is kept to a minimum. Injury of listed plants can be reduced but not eliminated through careful application of treatments or limited treatment intensity and/or duration, and by considering local species distribution.

The following project design features and conservation measures are relevant to all wildlife, including special status species, and would avoid or minimize adverse impacts:

- **WL-01** Avoid treating vegetation during time-sensitive periods (e.g., nesting and migration and sensitive life stages) for special status species in areas to be treated, when appropriate (wetland treatments will be done during the growing season when birds and other species are active and breeding). Time vegetation treatments to take place when foraging pollinators are least active, both seasonally and daily.
- **WL-02** Use area buffers around sensitive habitats, such as wetlands, riparian zones, and special status species locations, to minimize adverse effects. The exception to this is when treatments occur in wetland and riparian areas for the benefit of the wetland and related special status species.
- **WL-03** Treatments should be rotated so that various successional stages, heights, and densities are developed over varying years and on different sites across the landscape.

- **WL-04** Treatment design and location will consider wildlife habitat concerns, such as diversity, cover, movement corridors, and connectivity.
- **WL-05** Minimize treatments near fish-bearing water bodies during periods when fish are in life stages most sensitive to the herbicides used and use spot rather than broadcast or aerial treatments.
- **TA-05** Upon completion of the vegetation treatment, all temporary access routes will be evaluated for rehabilitation and closed to further traffic.
- **HT-05** Herbicides utilized will take into account target vegetation, sensitive plant and animal species, as well as sensitive land features, such as water sources and soil characteristics.
- **VG-01** Pre-treatment surveys for threatened, endangered, and sensitive plant species will be conducted via online resources (e.g., IPaC and HDMS), resource specialists, local subject matter experts, and on-site surveys. Design features for threatened and endangered species will be developed and implemented, per the requirements of the Biological Opinion from the USFWS.
- **VG-02** In riparian areas, use appropriate herbicide-free buffer zones for herbicides not labeled for aquatic use, based on risk assessment guidance, with minimum widths of 100 feet for aerial, 25 feet for vehicle, and 10 feet for hand-spray applications (BLM 2007).
- **WR-02** Herbicide treatments will be implemented between weather fronts and at appropriate time of day to avoid high winds that increase the potential for overland flow and to avoid potential stormwater runoff and water turbidity.
- **WR-01** Buffer widths between vegetation treatment areas and water sources will be developed based on treatment type and site-specific criteria to minimize impacts on water sources (e.g., wells, stock tanks, streams, and springs).
- **WR-03** Application of herbicides not designated for aquatic use will be avoided in rapidly permeable soils in areas that have potential for ground-surface water interaction, such as shallow water tables, to prevent groundwater contamination.
- **WR-04** Spray tanks will be rinsed only at approved staging areas; staging areas will be established away from bodies of water.

The proposed project would adhere to the requirements of the BO to avoid or minimize potential effects on listed ESA species in the planning area.

Applicable RMP plan components, design features, BO measures, and standard operating procedures and BMPs appropriate for specific activities under the proposed project would be identified during the design process and adhered to during implementation. Potential practices include site-specific wildlife surveys, seasonal and spatial avoidance buffers for breeding wildlife and when pollinators are least active, buffers around sensitive habitats, and future treatment-specific consultation with the USFWS, as needed. Such site-specific measures would avoid or minimize short-term adverse impacts on migratory birds, special status species, fish, aquatic species, and wildlife habitats.

Over the long term, vegetation management, riparian site restoration, and erosion control projects would move fish and wildlife habitat toward reference conditions and improve habitat suitability for special status species. Proposed project efforts should increase watershed cover by promoting increased perennial grasses and stabilizing vegetation along streams. Project treatments would improve watershed conditions, reduce sedimentation, and reduce the frequency of peak flood flows, which would benefit wildlife, fish, and special status species. These erosion control and stream restoration projects would enhance habitats for riparian-dependent and aquatic species.

Cumulative Impacts

Cumulative impacts on terrestrial wildlife, including special status species, would be similar to those described under the no action alternative. The cumulative effects of climate change and ongoing surface-disturbing activities in and near the planning area would contribute to long-term changes to wildlife throughout the planning area; however, under the proposed action, vegetation management, riparian site restoration, and erosion control projects would result in increased effectiveness to meet vegetation objectives in the RMP. Efforts to maintain upland areas; reduce undesirable woody species; restore and maintain mesquite bosques, wetlands, and cottonwood willow galleries; and control noxious, invasive species at a coordinated landscape level, as well as minimize erosion impacts, would improve wildlife habitat and improve resilience for the climate change-related impacts on wildlife and their habitats with greater effectiveness over the long term compared with the no action alternative.

Past, present, and reasonably foreseeable activities in the planning area with the potential to affect aquatic wildlife include other stream restoration/erosion projects; reintroduction of native species, including beavers; groundwater pumping; drought; and climate change.

Water reductions from groundwater pumping for domestic uses, agriculture, and mining are concerns for riparian habitat in the NCA as groundwater is supplied by the Cienega Creek aquifer. Perennial surface flows that remain continuous in a few reaches during a substantial portion of the year are necessary for the persistence of fish species (Stefferud and Stefferud 1998). As such, stream flow has a strong influence on the population dynamics of native fishes. In addition, by lowering the water table, these reduced water levels have led to the loss of some mature trees which, in turn, has accelerated erosion and caused headcutting in some reaches (USFWS 2016). In addition, low stream flows have rendered some habitats in Cienega Creek anoxic (low dissolved oxygen levels) and unsuitable for fish.

Continuing drought and climate change are likely to affect watersheds and subsequently waterbodies. Recent climate change trends in the Southwest include warming, unusually severe drought, and lower flows in the four major drainage basins of the Southwest (Garfin et al. 2013). Future climate change scenarios generally predict these trends to continue during the twenty-first century (Seager et al. 2007), which would likely exacerbate the effects of water reductions from human use.

Erosion control and stream restoration projects have been constructed in Los Pozos Gulch and on Cienega Creek near the agricultural fields and its confluence with Springwater Canyon. In addition, Pima County has implemented seven erosion control and restoration projects completed between 1994 and 2015 in the Cienega Creek Natural Preserve. Short-term effects from vegetation, stream restoration, and erosion treatments on the NCA would accumulate with impacts from other vegetation projects, climate change, and water withdrawals; but overall long-term improvements in the ecosystem health and aquatic habitat with success and maintenance of treatments would offset short-term losses. Over the long term, treatments should restore native vegetation and natural fire regimes and benefit ecosystem health, wildlife, and their habitats.

Wetlands on a regional scale (Arizona and New Mexico) would benefit from the cumulative beneficial effects to the maintenance or improvement of ecological integrity and function in the Cienega Creek basin and allow for the continued and future recovery of federally listed aquatic and wetland plants and animals. Together with other ongoing and planned restoration efforts in the basin and the region, along with those recovery efforts for listed species across their individual ranges, the proposed action would have a large beneficial cumulative impact over time and at a regional scale.

3.4 Visual Resources

- Issue 1: How would the impact from large-scale vegetation treatment techniques affect the viewshed of riparian and upland communities?

3.4.1 Affected Environment

More than 45,000 acres of rolling grasslands and woodlands in southeastern Arizona are protected under the Las Cienegas NCA. The region’s oak-studded hills connect several “sky island” mountain ranges and lush riparian corridors. With its perennial flow, Cienega Creek supports diverse plant and animal communities. Unique and rare vegetation communities include five of the rarest habitat types in the southwest United States: cienegas (marshlands), cottonwood-willow riparian forests, sacaton grasslands, mesquite bosques, and semidesert grasslands (BLM 2019b).

It is also rich in historic and archaeological resources. The Empire and Cienega Ranches, along with portions of the adjacent Rose Tree and Vera Earl Ranches, are under public ownership and managed by the BLM under the principles of multiple-use and ecosystem management (BLM 2019b).

Highway 83, which runs along the planning area boundary and crosses the planning area for 2 miles, is a designated scenic route in Arizona's State Highway System. The viewshed or scenery from Highways 82 and 83 and the Empire Ranch Road includes undisturbed panoramas of rolling grasslands with an average elevation of 4,500 feet against the dramatic backdrops of the mountain sky islands of Coronado National Forest, the 9,400-foot summit of Mount Wrightson in the Santa Rita Mountains to the west, and the 7,700-foot summit of Apache Peak in the Whetstone Mountains to the east. To the southeast is the distinctive hump of 6,300-foot Biscuit Mountain in the Mustang Mountains; to the north and south are the gentler vistas of the Empire Mountains and the Canelo Hills (BLM 2002).

Cienega Creek's riparian vegetation and the oak woodlands in other drainages create a dramatic greenbelt that magnifies the overall scenic quality of the rolling grass and oak- and agave-covered hills and offers a sharp contrast to nearby views of desert scrub. Along Cienega Creek, however, is a limited area that farming has visually degraded (BLM 2002).

Some vantage points along the interior roads of the planning area reveal arroyo cutting, abandoned water diversion structures, a 0.25-mile-long abandoned dirt airstrip, heavily trampled livestock watering holes, badlands topography, old dumps, and cut mesquite bosques. These features, while constituting a measurable degree of visual contrast with the surrounding visual setting, do not detract from the planning area's overall scenic quality (BLM 2002).

A 1-mile segment of Empire Gulch near the historic Empire Ranch headquarters consists of a visually spectacular Fremont cottonwood gallery forest. Views from the historic Ranch House, especially the breezeway and bay window, are generally unspoiled except for the Doppler radar tower in the Empire Mountains and the abandoned airstrip, which is occupied 5 to 10 times per year with small (1 to 20 vehicles) to large (20 to 70 vehicles) groups for periods of up to 2 weeks (BLM 2002).

The BLM is responsible for managing the public lands for multiple uses, and for ensuring that the scenic values of public lands are considered when providing for various uses. The BLM visual resource management (VRM) system involves inventorying scenic values and establishing management objectives for those values through the resource management planning process. The approved VRM objectives (Classes I through IV) provide the visual management standards for the design and development of future projects and for rehabilitation of existing projects (BLM 1984).

Within the proposed action area, there are 51,300 acres of VRM Class II, which describes a landscape that is largely unmodified and scenic. The remaining lands are not BLM-administered lands and, therefore, are not designated with a VRM class. The objective of VRM Class II is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but they should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape (BLM 1986).

The remaining non-BLM-administered lands are mostly north and south of the Las Cienegas NCA. Like Cienega Creek, the Babocomari River (south of the Las Cienegas NCA) begins near the community of Elgin, Arizona and drains into the Sonoita Basin and is surrounded by riparian vegetation and grassland. The Babocomari River begins near the community of Elgin, Arizona. Other developments in the proposed action area include Clyne and Sands Ranches (east of the Las Cienegas NCA) and Bar V and Empirita Ranches (north of the Las Cienegas NCA). The areas north of the Las Cienegas NCA are dominated by scrub uplands and contain the highest elevations in the proposed action area in the Coronado National Forest and foothills of the Santa Rita Mountains.

3.4.2 Impacts from the No Action Alternative

The proposed action area is the geographic scope of the analysis area for direct and indirect impacts. Designated transportation routes would be locations from which direct and indirect impacts would be viewed.

Direct and Indirect Impacts

Under this alternative, the BLM would not implement the proposed vegetation treatments or erosion control projects and would not maintain previous vegetation treatment areas. The agency could implement vegetation treatments that are identified under existing NEPA documentation (EA # 420-2006-19). Ongoing impacts on the form, line, color, or texture of the landscape from those vegetation treatments would continue. There would be no new impacts on the form, line, color, or texture of the landscape from temporary roads, temporary equipment and vehicles, or vegetation changes from treatments.

Cumulative Impacts

The proposed action area is the geographic scope of the analysis area for cumulative impacts. Designated transportation routes would be locations from which cumulative impacts would be viewed.

Past, present, and future actions that have affected and would affect visual resources include vegetation treatments, wildfires, livestock grazing, climate change, and Forest Service vegetation treatments within a 90,000-acre project area (though not all acres would be treated) in the upper part of the watershed. Previously, the BLM completed vegetation treatments on approximately 19,500 acres using prescribed fire, chemical, and mechanical methods in the Las Cienegas NCA. Erosion control and stream restoration projects have been constructed in Los Pozos Gulch and on Cienega Creek near the agricultural fields and its confluence with Springwater Canyon. Past, present, and future actions have affected and would affect visual resources by removing vegetation, altering the composition of vegetation, and changing conditions (such as temperature and precipitation) that support vegetation health and spread.

3.4.3 Impacts from the Proposed Action

Direct and Indirect Impacts

The types of actions associated with the project, including staging of construction equipment and creation of temporary roads, would be short-term actions occurring for the duration of the treatments. Vegetation would be removed from these areas, exposing the bare soil. The removal of vegetation can change the overall form of vegetation, introduce abrupt vegetation lines and bands of exposed soil, change the composition of colors in the landscape, and change the local vegetation texture. These impacts would depend on a variety of factors, including the type and density of existing vegetation and the amount and location of vegetation removed. The acres of staging areas and miles of temporary roads are unknown.

Denuded staging areas and temporary roads would be remediated after the vegetation treatment. This could include raking tracks, mulching, or reseeding or other techniques proven to be effective for remediation. Also, the BMPs listed in Appendix B, Best Management Practices, would minimize the degree of potential negative impacts, to the extent possible. As long as the BMPs are followed, the extent of impacts would be consistent with the VRM Class II definition. The impacts would gradually diminish over time after successful remediation and desired vegetation matured. To further minimize the degree of potential negative impacts, VRM Class II objectives could be applied to non-BLM-administered lands.

During the proposed action, crews may be working concurrently at various locations. Views of the proposed action area would be cluttered with construction equipment and construction materials. The bold colors and geometric, boxy forms of artificial construction vehicles, materials, and equipment would not resemble the colors and forms of the surrounding terrain and vegetation. They would create various focal points on an open landscape and would not resemble other landscape elements, which is mostly vegetation. These impacts would be temporary and would occur only when construction equipment and construction materials are present.

Prescribed burns are temporary and although they result in vegetation removal, including leaving dark patches on the landscape, the recovery process is quick due to a greater chance of precipitation in the area. Manual treatments would involve selecting certain vegetation to remove. Both actions would not significantly change the visual class definition of what is assigned to the NCA from the current RMP. After all proposed actions and the successful establishment and maturity of vegetation in treated areas, however, vegetation communities would be established that promote desired future conditions. This would consist of vegetation communities that are maintained within their natural range of variation in plant composition, structure, and function, thereby creating a natural landscape that is appropriate to the region. This would be a long-term beneficial impact on visual resources.

Cumulative Impacts

The proposed action area is the geographic scope of the analysis area for cumulative impacts. Designated transportation routes would be locations from which cumulative impacts would be viewed. Past, present, and future actions are described above under Section 3.4.2**,** Impacts from the No Action Alternative.

Past, present, and future actions have affected and would affect visual resources by removing vegetation and altering the composition of vegetation. In addition, changing conditions (such as temperature and precipitation) that support vegetation health and spread would also affect visual resources. Because the proposed action would ultimately restore vegetation communities and not degrade landscape conditions, the proposed action would not contribute to cumulative impacts that degrade visual resources and affected areas would remain consistent with the visual class objectives as defined in the current RMP.

3.5 Recreation

- Issue 1: How would the proposed action impact special recreation permittees (e.g. bird-dog trial groups, endurance equestrian riders)?
- Issue 2: How would the proposed action impact dispersed recreation users (e.g. hunters, campers, OHV users)?

3.5.1 Affected Environment

There are recreational opportunities in the Las Cienegas NCA. Recreation is concentrated at the historic Empire Ranch and six designated campgrounds, including group campgrounds at Maternity Well, Ag Fields, and the Airstrip. Motorized, unpaved access to these sites is primarily via Empire Ranch Road (LC6900) and Yucca Farm Road from Highways 82 and 83. Table E-13 shows the average annual daily traffic, measured in number of vehicles, for six locations in the NCA.

Total estimated traffic to the NCA between 2019 and 2021, excluding the annual Empire Ranch Cowboy Festival, was 118,054, which equates to 59,027 total vehicles counted (BLM 2021c). Most visitors access recreation opportunities in the NCA via Empire Ranch Road where the average annual daily traffic, excluding the annual Empire Ranch Cowboy Festival, is 89 vehicles. During the festival, daily traffic exceeds 1,100 vehicles. Less than 10% of all vehicles enter the NCA from the south (BLM 2021c).

Examples of recreational opportunities include camping in designated primitive campgrounds, walking on an interpretive trail near Empire Gulch, driving for pleasure, and interpreting historic architecture and cattle ranching at Empire Ranch. The Empire Ranch House, Oak Tree Canyon camp area, and the Airstrip group site are the most frequently visited sites in the NCA for these types of recreational opportunities (BLM 2021d). Other more dispersed recreation also occurs in the NCA. This includes hiking, horseback riding, hunting, mountain biking, nature photography, night sky viewing, OHV riding, and wildlife viewing.

BLM recreation management information system data indicate that camping, horseback riding, viewing cultural sites, walking on dog trails, and OHV riding are the most popular activities with an average of 54,598 participants collectively engaging in these activities between October 2018 and September 2021 (BLM 2021d). These activities typically occur near developed sites accessed via Empire Ranch or Yucca Farm Roads.

In 2019 and 2020, the BLM also issued 19 special recreation permits (SRPs) for group activities in the NCA. In 2021, the BLM issued 24 SRPs for group activities. These included seven SRPs for a series of competitive bird dog trials, which occur annually in late December through early March at the Airstrip and Maternity Well group sites. The BLM also issues commercial and organized group event SRPs for equestrian rides, hunting outfitters, and all-terrain vehicle tours (BLM 2021d). In November, the annual Empire Ranch Cowboy Festival allows visitors to experience Western heritage demonstrations and ranching exhibits; the BLM issues an SRP for the festival.

Recreation in the NCA is seasonal, with the highest visitation between October and May (BLM 2021c,d) when average high temperatures are between 60 and 80 degrees Fahrenheit. In the summer months, the average high temperature is approximately 90 degrees with high temperatures often exceeding 100 degrees. Monsoonal thunderstorms are also most frequent in July and August (NOAA 2019). These factors discourage or preclude many outdoor recreation activities in the NCA during the summer.

3.5.2 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, the BLM would not implement vegetation treatments or erosion control projects, nor would it maintain previous vegetation treatments. There would be no displacement of visitors, SRP activities, or changes to the recreation experiences or settings from treatment projects (except for treatments that would occur under existing NEPA); however, the continued invasion of riparian and upland areas by noxious weeds would contribute to increasing soil erosion and wildfire potential. Eroded soils can reduce the quality of road and trail surfaces, campsites, and undeveloped areas visible to visitors. Wildfire would displace visitors and potentially damage recreation infrastructure. These changes could reduce the commercial viability of some SRP operations. After fire, the setting within and around standing dead vegetation would provide for lower-quality recreation experiences compared with unburned areas. Unstable soils would be more likely to erode. Emergency stabilization and recovery treatments following fire could result in the temporary displacement of visitors and SRP activities in the treatment area.

Cumulative Impacts

Combined with past, present, and reasonably foreseeable future actions, the no action alternative would result in the potential for vegetation community departure to accelerate soil erosion and wildfire potential. Where these outcomes occur, there would be a change in the recreation setting and the associated quality of the recreation experience. Impacts would be greatest where erosion and wildfire occur within or in proximity to developed sites, trails, and roads. With increasing vegetation community departure and potential for wildfire that would lead to erosion and burn scars, more frequent emergency stabilization and recovery treatments in or near popular recreation areas would increasingly displace visitors.

3.5.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Issue 1: How would the proposed action impact special recreation permittees (e.g. bird-dog trial groups, endurance equestrian riders)?

Prescribed fire, mechanical, manual, and herbicide treatments under the proposed action could result in the temporary displacement of visitors participating in SRP activities. The location and extent of displacement would depend on the treatment location, type, and size. Because many permitted activities are scheduled events and typically occur annually, proposed treatments would likely be planned around those events so as to not temporarily displace those engaged in specially-permitted activities.

Smoke from prescribed fire treatments and noise from mechanical and manual treatments would indirectly diminish the quality of the recreation setting and associated visitor experiences. The magnitude of direct and indirect impacts would decline with increasing distance from the treatments. Smoke from prescribed fire and noise from mechanical or manual treatments would directly and indirectly impact SRP activities where treatments occur at the same time and are located near the specially-permitted event. Treatments that take place at a different time of year would not result in direct or indirect impacts on specially permitted events from smoke or noise.

For some SRP participants, unburned slash burn piles could diminish the quality of the recreation setting and associated experiences. Piles visible from the primary access routes or event location would have the greatest potential to conflict with visitors' desired recreation setting, which would lead to a greater impact than from piles located elsewhere in the project area.

Slow-moving vehicles accessing treatments could increase the travel times for some visitors using the same roads to access specially permitted events. If the treatment and the event occur at the same time, impacts would be temporary. There would be no impact if the treatment and special event occur at different times of the year.

Aircraft used during aerial herbicide treatments could temporarily displace visitors at the Airstrip group site engaged in SRP activities. Aircraft noise would temporarily affect the recreation setting and associated experiences. However, it is unlikely that aircraft activity associated with treatments would coincide with scheduled SRP events at the Airstrip.

The greatest potential for impacts under the proposed action would be from October to May when the greatest number of specially-permitted activities take place. Treatments in November, December, and January near the Empire Ranch or Airstrip group site would have the potential to affect visitors engaged in SRP activities in those locations. However, the SRP events are pre-planned, annual events; treatments would likely be planned so as to not coincide with the events.

Under the proposed action, there would be a long-term reduction in the types of impacts described under the no action alternative.

Issue 2: How would the proposed action impact dispersed recreation users (e.g. hunters, campers, OHV users)?

The types of impacts would be similar to those described for Issue 1, with the exception that treatments would be more likely to displace visitors or affect recreational experiences and settings for dispersed users. This is because dispersed recreation occurs more often and over a larger area compared with specially-permitted activities. Compared with specially-permitted events, the potential for incidents of treatments impacting dispersed recreation activities would be higher; however, the number of people with the potential to be impacted would be less because fewer people engage in dispersed recreation.

Cumulative Impacts

Combined with past, present, and reasonably foreseeable future actions, the proposed action would result in the temporary displacement of SRP holders and dispersed recreation activities; however, over the longer term, treatments would reduce the potential for the types of cumulative impacts described under the no action alternative. Compared with the no action alternative, treatments implemented under the proposed action would incrementally restore vegetation communities to desired conditions, reducing the potential for erosion and wildfire, which would improve the long-term quality of the recreation setting and the associated visitor experiences.

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4 SUPPORTING INFORMATION

4.1 Tribes, Individuals, Organizations, or Agencies Consulted

4.1.1 Tribal Consultation

The BLM initiated government-to-government consultation with 10 Native American Tribes who claim cultural affiliation to and/or traditional use of the project planning area. Letters summarizing the proposed action were sent to the Fort Sill Apache Tribe, Hopi Tribe, Mescalero Apache Tribe, Pascua Yaqui Tribe, San Carlos Apache Nation, Tohono O'odham Nation, Tonto Apache Tribe, White Mountain Apache Tribe, Yavapai-Apache Nation, and Zuni Tribe on October 1, 2021.

The Tohono O'odham Nation responded via phone message on October 5, 2021, therein requesting additional information on the proposed plan and expressing interest in receiving copies of future, related cultural and biological resources assessments for review and consultation. The Yavapai-Apache Nation responded via email on October 18, 2021, stating that the Tribe had no concerns or comments, therein deferring to the San Carlos and Mescalero Apache Tribes. The White Mountain Apache Tribe responded via letter dated October 22, 2021, stating that the proposed plan posed no adverse effect to the Tribe's cultural heritage resources and/or traditional cultural properties. The Hopi Tribe responded via letter dated October 23, 2021, requesting hard copies of the proposed plan and draft EA, along with their interest to develop an Assistance Agreement to participate in implementation-level resource studies. To date, no other responses or comments have been received; however, Tribal consultation is considered ongoing and will continue throughout plan implementation.

Currently, there are no known or likely impacts to any culturally significant plants, items, sites, or landscapes. Any new information provided by consulting Tribes could prompt issue(s)-analysis and/or alternatives development. Likewise, the BLM may later apply additional or edited terms and conditions of project implementation or require mitigation to protect or restore culturally significant resource values.

4.1.2 U.S. Fish and Wildlife Service Consultation

The BLM consulted with the US Fish and Wildlife Service as part of the requirements under Section 7(a)(2) of the Endangered Species Act. The BLM received the final Biological Opinion from the US Fish and Wildlife Service on August 17, 2023.

4.2 List of Preparers

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Jeff Simms	Aquatic species and aquatic special status species
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Robert Walter	Recreation; visual resources
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4.3 References

Abrahams, A. D., A. J. Parsons, and J. Wainwright. 1994. “Resistance to overland flow on semiarid grassland and shrubland hillslopes, Walnut Gulch, Southern Arizona.” *Journal of Hydrology* 156(1-4): 431–446.

_____. 1995. “Effects of vegetation change on interrill runoff and erosion, Walnut Gulch, Southern Arizona.” *Geomorphology* 13(1-4): 37–48.

Ahlstrand, G. M. 1982. “Response of Chihuahuan Desert mountain shrub vegetation to burning”. *Journal of Range Management*. 35(1): 62-65.

AGF (Arizona Game and Fish). 2019. In the Field: Native Fish Introductions in Las Cienegas National Conservation Area. Internet website: https://inthecurrent.org/itf/native-fish-introductions-las-cienegas-national-conservation-area/.

Anable, M. E., M. P. McClaran, and G. B. Ruyle. 1992**. “**Spread of introduced Lehmann lovegrass Eragrostis lehmanniana Nees. in Southern Arizona, USA.” *Biological Conservation* 61(3): 181–188.

Anderson, T.W., G. W. Freethey, and P. Tucci. 1989. Geohydrology and Water Resources of Alluvial

Basins in South-Central Arizona and Parts of Adjacent States. Regional aquifer-system analysis. US Geological Survey Professional Paper 1406-B. Denver, Colorado.

Britton, C.M. and Sneva, F.A., 1981. Effects of tebuthiuron on western juniper. *Rangeland Ecology & Management/Journal of Range Management Archives*. 34(1): 30-32.

Arizona Department of Environmental Quality. 2016. 18 Arizona Administrative Code 11. Title 18. Environmental Quality. Chapter 11. Department of Environmental Quality - Water Quality Standards. Supplement 16-4. December 31, 2016. Phoenix, Arizona.

Arizona Important Bird Areas Program. 2011. Las Cienegas NCA IBA: Arizona Important Bird Areas Program. Internet website: http://aziba.org/?page_id=2358/.

_____. 2018. Bringing Birds Home. Internet website: http://aziba.org/wordpress/wp-content/uploads/2018/03/TAS_IBA_Grasslands_web_higer-res.pdf.

Bahre, C. J. 1991. A legacy of change: historic human impact on vegetation in the Arizona borderlands: University of Arizona Press, Tucson.

Belnap, J. 2003. “The world at your feet: Desert biological soil crusts.” *Frontiers in Ecology and the Environment* 1(4): 181–189.

Belnap, J., R. Rosentreter, S. Leonard, J. Hilty Kaltenecker, J. Williams, and D. Eldridge. 2001. Biological Soil Crusts: Ecology and Management. Technical Reference 1730-2.

BLM (US Department of the Interior Bureau of Land Management). 1984. Manual 8400—Visual Resource Management. Rel. 8-24, April 5, 1984. BLM, Washington, DC.

_____. 1986. Handbook H-8410-1—Visual Resource Inventory. Rel. 8-28, January 17, 1986. BLM, Washington, DC.

_____. 1988. Phoenix Resource Management Plan and Final Environmental Impact Statement. Phoenix, Arizona.

_____. 1991a. Safford District Resource Management Plan and Environmental Impact Statement. Safford, Arizona.

_____. 2002. Proposed Las Cienegas Resource Management Plan and Final Environmental Impact Statement. Tucson Field Office, Tucson, Arizona. June 2002.

_____. 2003. Approved Las Cienegas Resource Management Plan and Record of Decision. U.S. Department of Interior, Bureau of Land Management, Tucson, Arizona.

_____. 2006. Wetland Restoration, Aquatic Habitat Enhancement for the Re-establishment of Special Status Species on the Las Cienegas NCA. Wetland Restoration EA Excerpts for LCNCA wetland descriptions. EA# AZ-420-2006-026. Tucson Field Office, Arizona.

_____. 2007. Vegetation Treatments Using Herbicides on BLM Lands in 17 Western States Programmatic Environmental Impact Statement (PEIS) and Record of Decision. Washington, DC.

_____. 2010. FY 2011 Annual Manager's Report. Las Cienegas National Conservation Area. Internet website: http://www.cienega.org/wp-content/uploads/2016/11/Las-Cienegas-Managers-Report-20011.pdf.

_____. 2011. Wetland Restoration, Aquatic Habitat Enhancement for the Re-establishment of Special Status. EA#: DOI-BLM-AZ-G020-0021. Tucson, Arizona.

_____. 2015. Las Cienegas Resource Management Plan Evaluation. October 2015. BLM, Arizona State Office, Phoenix.

_____. 2016a. Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on BLM Lands in 17 Western States PEIS and Record of Decision. Washington, DC.

_____. 2016b. Wild and Scenic River Eligibility Report. San Pedro Riparian National Conservation Area. Tucson Field Office, Arizona. May 2016.

_____. 2017. AIM National Aquatic Monitoring Framework: Field Protocol for Wadeable Lotic Systems. Tech Ref 1735-2. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO.

_____. 2018. Brush Treatment for Grassland Restoration As Part of an Adaptive Management Framework in the Cienega Creek Watershed. Internet website: https://lccnetwork.org/sites/default/files/Resources/Brush%20Treatment%20for%20Grassland%20Restoration%20as%20Part%20of%20an%20Adaptive%20Management%20Framework%20in%20the%20Cienega%20Creek%20Watershed.pdf.

_____. 2019a. Unpublished Data. Tucson Field Office.

_____. 2019b. Las Cienegas National Conservation Area. Internet website: https://www.blm.gov/national-conservation-lands/arizona/las-cienegas.

_____. 2021c. Las Cienegas NCA 2019-2021 Traffic Sampling Data. Tucson, Arizona.

_____. 2021d. Recreation Management Information System Data for October 1, 2018 to September 30, 2021. Tucson, Arizona.

_____. 2019e. Supplemental AIM-NAMF Field Protocol for Wadeable Lotic Systems. Supp. TR-1735-2 Field Methods Protocol. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO.

BLM GIS. 2019. GIS data from the BLM's Arizona GIS server, including data for ecosites and vegetation groups, previous vegetation treatments, potential erosion treatments, visual resource management, and hydrographic data.

Bock, Carl E., Bock, Jane H. 1997. Shrub Densities in Relation to Fire, Livestock Grazing, and Precipitation in an Arizona Desert Grassland. The Southwestern Naturalist, Jun., 1997, Vol. 42, No. 2 (Jun., 1997), pp. 188-193.

Bodner, G., and K. Simms. 2008. State of the Las Cienegas National Conservation Area. Part 3. Condition and Trend of Riparian Target Species, Vegetation and Channel Geomorphology. Prepared by The Nature Conservancy in Arizona and Bureau of Land Management, Tucson, Arizona. January 2008.

Brady, N. C., and R. R. Weil. 2008. *The Nature and Properties of Soils* (Vol. 13). Prentice Hall, Upper Saddle River, New Jersey.

Carveth, J., A. Widmer, and S. Bonar. 2006. “Comparison of Upper Thermal Tolerances of Native and Nonnative Fish Species in Arizona.” *Transactions of the American Fisheries Society* 135: 1433–1440.

Caves, J. K., G. S. Bodner, K. Simms, L. A. Fisher, and T. Robertson. 2013. “Integrating collaboration, adaptive management, and scenario-planning: Experiences at Las Cienegas National Conservation Area.” *Ecology and Society* 18(3): 43. Internet website: http://dx.doi.org/10.5751/ES-05749-180343.

Cienega Watershed Partnership. 2018. Second Annual State of the Health of the Cienega Watershed. March 6, 2018. Internet website: http://www.cienega.org/wp-content/uploads/2018/10/2018-State-of-the-Watershed-.pdf.

Ciotti, Damian. 2020. "Restoration design concepts" Presentation in Ecological Restoration of Wet Meadows and Streams Webinar. Hosted by Sacramento-Shasta Chapter of The Wildlife Society. May 13,2020.

Conway, C. J., C. P. Nadeau, and L. Piest. 2010. “Fire helps restore natural disturbance regime to benefit rare and endangered marsh birds endemic to the Colorado River.” *Ecological Applications* 20(7): 2024–2035.

Cox, J. R., and G. B. Ruyle. 1986. “Influence of climatic and edaphic factors on the distribution of Eragrostis lehmanniana Nees in Arizona, USA.” *Journal Grassland Society of S. Africa* 3(1): 25–29.

Dobyns, H. F. 1981. *From fire to flood: historic human destruction of Sonoran Desert riverine oases* (No. 20). Socorro, New Mexico: Ballena Press.

Emmerich, V. E., and J. R. Cox. 1992. “Hydrologic characteristics immediately after seasonal burning on introduced and native grasslands.” *Journal of Range Management* 45: 476–479.

Field, J. P., D. D. Breshears, J. J. Whicker, and C. B. Zou. 2011. “Interactive effects of grazing and burning on wind- and water-driven sediment fluxes: Rangeland management implications.” *Ecological Applications* 21(1): 22–32.

Fogg, J., W. Elmore, and M. Gonzalez. 2012. Riparian Conditions Along the San Pedro River: Potential Natural Communities and Factors Limiting their Occurrence. Lowclouds Hydrology, Inc., Highlands Ranch, Colorado.

Forest Service. 2017. “Don’t Bust the Biological Soil Crust: Preserving and Restoring an Important Desert Resource.” *Science You Can Use Bulletin*. Issue 23. Rocky Mountain Research Station. January/February 2017.

Garfin, G., A. Jardine, R. Merideth, M. Black, and S. LeRoy, editors. 2013. Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment. A report by the Southwest Climate Alliance. Island Press, Washington, DC.

Gibbens, R. P., C. H. Herbel, and J. M. Lenz. 1987. Field-scale tebuthiuron application on brush-infested rangeland. *Weed Technology*. 1:323–327.

Gillette, D. A., and Pitchford, A. M. 2004. Sand flux in the northern Chihuahuan Desert, New Mexico, USA, and the influence of mesquite-dominated landscapes. Journal of Geophysical Research: Earth Surface, 109(F4).

Gori, D., and H. Schussman. 2005. State of the Las Cienegas National Conservation Area. Part I. Condition and Trend of the Desert Grassland and Watershed. Prepared by The Nature Conservancy of Arizona. 63 pp.

Gray, E. 2018. Using Water Isotopes and Solute Chemistry to Investigate the Hydrology of Surface Water in the Cienega Creek Watershed, Master’s Thesis, University of Arizona.

Hastings, J. R. and R. M. Turner. 1965. The changing mile. An ecological study of vegetation change with time in the lower mile of an arid and semiarid region. University of Arizona Press Tucson.

Hendrickson, D.A., and W.L. Minckley. 1984. Ciénegas: Vanishing climax communities of the American southwest. *Desert Plants* 6(3):131-174. Internet website: https://www.rosemonteis.us/documents/048756.

Hernandez, M., M. A. Nearing, J. J. Stone, F. B. Pierson, H. Wei, K. E. Spaeth, P. Heilman, et al. 2013. “Application of a rangeland soil erosion model using National Resources Inventory data in southeastern Arizona.” *Journal of Soil and Water Conservation* 68(6): 512–525. November/December 2013.

Huth, H. J.. 1997. Hydrogeochemical Modeling of Western Mountain Front Recharge, Upper Cienega Creek Sub-Basin, Pima County, Arizona. Master’s Thesis, University of Arizona, Tuscon.

Huxman, T. E., B. P. Wilcox, D. D. Breshears, R. L. Scott, K. A. Snyder, E. E. Small, K. Hultine, et al. 2005. “Ecohydrological Implications of Woody Plant Encroachment.” *Ecology* 86(2): 308–319.

Kaib, M., C.H. Baisan, H.D. Grissino-Mayer, and T.W. Swetnam. 1996. Fire History in the Gallery Pine-Oak Forests and. In *Effects of Fire on Madrean Province Ecosystems: A Symposium Proceedings*. 289: 253. USDA Forest Service.

Killgore, A., E. Jackson, W.G. Whitford. 2009. "Fire in Chihuahuan Desert grassland: short-term effects on vegetation, small mammal populations, and faunal pedoturbation." *Journal of Arid Environments*, *73*(11): 1029-1034.

Kline, M., and B. Cahoon. 2010. "Protecting River Corridors in Vermont." *Journal of the American Water Resources Association* 1–10. DOI: 10.1111⁄j.1752-1688.2010.00417.x

Ladwig, L.M., S.L Collins, P.L. Ford, and L.B. White. 2014. "Chihuahuan Desert grassland responds similarly to fall, spring, and summer fires during prolonged drought." *Rangeland Ecology & Management*. 67(6): 621-628.

LANDFIRE. 2019. Existing Vegetation Type. Internet website: https://www.landfire.gov/evt.php.

Launchbaugh, K., and J. Walker (eds). 2006. "Targeted Grazing: A natural approach to vegetation management and landscape enhancement." American Sheep Industry Association, Colorado.

Leenhouts, J. M., J. C. Stromberg, and R. L. Scott, editors. 2006. Hydrologic Requirements of and Consumptive Ground-water Use by Riparian Vegetation Along the San Pedro River, Arizona. US Geological Survey Scientific Investigations Report 2005–5163. US Geological Survey, Tucson, Arizona.

MacNish, Robert D., C. F. Smith, and Kimball E. Goddard. 1993. Floods in Arizona, January 1993. No. 93-54. US Geological Survey, Department of the Interior, Tucson, Arizona.

Montgomery & Associates. 1995. Empirita Ranch Monitoring Program Reports: 1984, 1985, 1986, 1987, 1988, 1989, 1990, and 1991. From Figure 8. Cienega Creek Streamflow Location, Tucson, Arizona.

NatureServe. 2018. Terrestrial Ecological Systems of CONUS and Puerto Rico on the LANDFIRE Legend. Internet website: https://www.landfire.gov/documents/LANDFIRE_Ecological_Systems_Descriptions_CONUS.pdf.

_____. 2019. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Internet website: http://explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722920

Nichols, M. H., V. O. Polyakov, M. A. Nearing, and M. Hernandez. 2016. "Semiarid watershed response to low-tech porous rock check dams." *Soil Science* 181(7): 275–282.

Neary, D. G., K. C. Ryan, and L. F. DeBano, eds. 2005 (revised 2008). Wildland fire in ecosystems: Effects of fire on soils and water. General Technical Report RMRS-GTR-42-vol.4. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, Utah.

NOAA. 2019. Average temperature and precipitation. Internet website: https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

Norman, L. M., J. B. Sankey, D. Dean, J. Caster, S. DeLong, W. DeLong, and J. D. Pelletier. 2017. "Quantifying geomorphic change at ephemeral stream restoration sites using a coupled-model approach." *Geomorphology* 283: 1–16.

Norman, L. M., J. B. Callegary, L. Lacher, N. R. Wilson, C. Fandel, B. T. Forbes, and T. Swetnam. 2019. "Modeling riparian restoration impacts on the hydrologic cycle at the Babacomari Ranch, SE Arizona, USA." *Water* 11(2): 381.

Northern Arizona University. 2019. Cienega Creek Natural Preserve. Arizona Heritage Waters. Internet website: http://www.azheritagewaters.nau.edu/loc_cienega.html.

NRCS (Natural Resources Conservation Service). 2019. Ecological Site Description. Internet website: https://esis.sc.egov.usda.gov/Welcome/pgReportLocation.aspx?type=ESD.

Perkins, S. R. and K. C. McDaniel. 2005. Infiltration and Sediment Rates Following Creosotebush Control With Tebuthiuron. Rangeland Ecology & Management 58(6): 605-613.

Peters, G., K. Morris, D. Frood, P. Papas, and J. Roberts. 2015. A Guide to Managing Livestock Grazing in Victoria's Wetlands. Decision Framework and Guidelines – Version 1.0. Arthur Rylah Institute for Environmental Research Technical Report Series No. 265. Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Petrakis, R. E., L. Norman, B. Middleton, N. Wilson, and G. Bodner. 2019. Las Cienegas National Conservation Area Mesquite Mapping Project. Western Geographic Science Center, US Geological Survey, Tucson, Arizona 85719. The Nature Conservancy, Tucson, Arizona 85719.

Pima Association of Governments. 2012. Shallow Groundwater Areas in Eastern Pima County, Arizona. Water Well Inventory and Pumping Trend Analysis. Pima County, Arizona. October 2012.

_____. 2014. Cienega Creek drought report 2013-14. Available online: www.pagnet.org/documents/water/CienegaDroughtReport2013-14.pdf

_____. 2018. Cienega and Davidson Flow Results 1999–2018. Unpublished Data.

Polyakov, V. O., M. A. Nearing, J. J. Stone, E. P. Hamerlynck, M. H. Nichols, C. D. Holifield Collins, and R. L. Scott. 2010. Runoff and erosional responses to a drought-induced shift in a desert grassland community composition, J. Geophys. Res., 115, G04027, doi:10.1029/2010JG001386

Polyakov, V. O., M. H. Nichols, M. P. McClaran, and M. A. Nearing. 2014. "Effect of check dams on runoff, sediment yield, and retention on small semiarid watersheds." *Journal Of Soil And Water Conservation* 69(5): 414–421.

Powell, B. F. 2013. Water Resource Trends in the Cienega Creek Natural Preserve, Pima County, Arizona. An unpublished report to the Pima County Flood Control District, Tucson, Arizona.

Robinett, Dan. 1994. "Fire effects on southeastern Arizona plains grasslands." *Rangelands* 16(4): 143-148.

Sabo, J. L., R. Sponseller, M. Dixon, K. Gade, T. Harms, J. Heffernan, A. Jani, G. Katz, C. Soykan, J. Watts, and J. Welter. 2005. "Riparian zones increase regional species richness by harboring different, not more, species." *Ecology* 86(1): 56-62.

Scott, R. L., W. J. Shuttleworth, D. C. Goodrich, and T. Maddock III. 2000. "The water use of two dominant vegetation communities in a semiarid riparian ecosystem." *Agricultural and Forest Meteorology* 105(1-3): 241–256.

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H. Huang, et al. 2007. "Model projections of an imminent transition to a more arid climate in southwestern North America." *Science* 316: 1181–1184.

Seyfried, M. S., and B. P. Wilcox. 2006. "Soil water storage and rooting depth: key factors controlling recharge on rangelands." *Hydrological Processes* 20: 3261–3275.

Shafiqullah, S. , M. Natharius, R. Ballard, D. Watson, and K. MacDonald. 2017. Sawmill Fire Soil Burn Severity Mapping Project. US Forest Service Burned Area Emergency Response Team. AZ-A3S-002926. May 7, 2017.

Simpson, S. C. 2007. "Modeling stream-aquifer interactions during floods and baseflow: Upper San Pedro River, southeastern Arizona." Master's thesis, University of Arizona, Tucson.

Skagen, S. K., C. P. Melcher, W. H. Howe, and F. L. Knopf. 1998. "Comparative use of riparian corridors and oases by migrating birds in southeast Arizona." *Conservation Biology* 12(4): 896-909.

Stefferud, J. A., and S. E. Stefferud. 1998. "Influence of Low Flows on Abundance of Fish in the Upper San Pedro River, Arizona." In "Cross Border Waters: Fragile Treasures for the 21st Century." Ninth US/Mexico Border States Conference on Recreation, Parks, and Wildlife, Tucson, Arizona, June 3–6, 1998 (p. 167). US Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Stromberg, J. 1993. Fremont Cottonwood-Godding Willow Riparian Forests: A review of their ecology, threats, and recovery potential. Internet website: http://www.ansac.az.gov/UserFiles/PDF/02232015/X055YANMontomery1/YAN-5_Fremont%20Cottonwood-Goodding%20Willow%20Riparian%20Forests%20-%20A%20Review%20of%20Their%20Ecology,%20Threats,%20and%20Recovery%20Potential.pdf.

Strong, T. R. and C. E. Bock. 1990. Bird species distribution patterns in riparian habitats in southeastern Arizona. *The Condor* 92(4): pp.866-885.

Tiller, R., D. Quintana, G. Bodner, and K. Simms. 2012a. Semi-desert grassland restoration in the Sky Island Region: Effectiveness of brush treatments and grassland response. Final report prepared for the National Fish and Foundation. Tucson, AZ.

_____. 2013. "Sacaton Riparian Grasslands of the Sky Islands: Mapping Distribution and Ecological Condition Using State-and-Transition Models in Upper Cienega Creek Watershed." In "Merging science and management in a rapidly changing world: Biodiversity and management of the Madrean Archipelago III". *In* G. J. Gottfried, P. F. Folliott, B. S. Gebow, L. G. Eskew, and L. C. Collins, editors. Proceedings, May 1–5, 2012, Tucson, Arizona. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

Tiller, R., M. Hughes, and G. Bodner. 2012b. Sacaton Riparian Grasslands: Mapping Distribution and Ecological Condition using State-and-Transition Models in the Upper Cienega Creek Watershed. The Nature Conservancy, Tucson, Arizona.

The Nature Conservancy. 2018a. Velvet Mesquite Thinning to Improve Riparian Forests along the San Pedro River. Desert Landscape Conservation Center (DLCC)—A Case Study in the Collaborative Conservation and Adaptation Strategy Toolbox (CCAST). Tucson, Arizona.

_____. 2018b. San Pedro River Surface Water Extent, June 2018. Internet website: http://azconservation.org/downloads/category/san_pedro_river.

Triepke, F.J., M.M. Wahlberg, D.C. Cress, and R.L. Benton. 2018. RMAP – Regional Riparian Mapping Project. USDA Forest Service project report available online < http://www.fs.usda.gov/main/r3/landmanagement/gis>. Southwestern Region, Albuquerque, NM. 53 pp.

Tucci, R. 2018. Using isotopes and solute tracers to infer groundwater recharge and flow in the Cienega Creek Watershed, SE Arizona, Master's Thesis, University of Arizona.

Uchytil, R. J. 1992. "Eragrostis lehmanniana." In "Fire Effects Information System, [Online]." US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Internet website: https://www.fs.fed.us/database/feis/plants/graminoid/eraleh/all.html.

USDA (United States Department of Agriculture). Undated. The 12 Orders of Soil Taxonomy. Internet website: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/data/?cid=nrcs142p2_053588.

USDA. 2017.Record of Decision: Rosemont Copper Project and Amendment of the Coronado Land and Resource Management Plan. US Forest Service. Coronado National Forest. Nogales Ranger District. June 2017. Internet Website: https://www.rosemonteis.us/sites/default/files/final-eis/rosemont-feis-final-rod.pdf

USFWS (US Fish and Wildlife Service). 1998. Reintroduction of Beaver into the San Pedro Riparian NCA (2-21-97-F-097). Phoenix, Arizona.

_____. 2008. Biological Opinion on Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas National Conservation Areas, Arizona (22410-2008-F-0103). Phoenix, Arizona.

_____. 2016. Formal Consultation and Conference Report on Twenty-five Fuel Break Treatment Sites on the Gila District within Graham, Pima, and Cochise Counties, Arizona. Phoenix, Arizona.

_____. 2017. Recovery plan for *Lilaeopsis schaffneriana* ssp. *recurva* (Huachuca water umbel). Arizona Ecological Services Field Office, Tucson, Arizona.

_____. 2019. IPaC Information for Planning and Consultation: Explore Location. Internet website: https://ecos.fws.gov/ipac/.

USGS (US Geological Survey). 2018. Las Cienegas National Conservation Area (LCNCA) Mesquite Mapping Project. Unpublished data.

_____. 2019. Water Quality After a Fire. Internet website: https://ca.water.usgs.gov/wildfires/wildfires-water-quality.html.

van Leeuwen, W., K. Hartfield, R. Tiller, and G. Bodner. 2012. Remotely Sensed Mapping of Woody Cover in Semi-Desert Grasslands of the Cienega Creek Basin and Sonoita Plain. Final report by the Arizona Remote Sensing Center and The Nature Conservancy in partial fulfillment of a contract with the Arizona Remote Sensing Center and a grant to The Nature Conservancy under the Sky Islands Grasslands Initiative of the National Fish and Wildlife Foundation. Tucson, Arizona.

Weltz, M. A., L. Jolley, M. Hernandez, K. E. Spaeth, C. Rossi, C. Talbot, M. Nearing, et al. 2014. "Estimating Conservation Needs for Rangelands Using USDA National Resources Inventory Assessments". *Transactions of the American Society of Agricultural and Biological Engineers* 7(6): 1559-1570.

Williams, C. J., F. B. Pierson, K. E. Spaeth, J. R. Brown, O. Z. Al-Hamdan, M. A. Weltz, M. A. Nearing, et al. 2016. "Incorporating hydrologic data and ecohydrologic relationships into ecological site descriptions." *Rangeland Ecology & Management* 69(2016): 4–19.

Zeedyk, W., and V. Clothier. 2009. Let the Water Do The Work: Induced Meandering, an Evolving Method for Restoring Incised Channels. The Quivara Coalition, Santa Fe, New Mexico.