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Brunckow Hill Land Health Evaluation

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Table of Contents

LIST OF ACRONYMS AND ABBREVIATIONS	iv
1 Introduction	1
1.1 Definitions of Arizona Standards for Rangeland Health and Guidelines for Grazing Administration.....	1
2 Allotment Profile and General Description	2
2.1 Location	2
2.2 Physical Description	2
2.2.1 Surface Land Ownership	2
2.2.2 Climate.....	2
2.2.3 Watershed and Water Resources.....	3
2.2.4 Soils.....	4
2.2.5 Range Improvements	4
2.2.6 Management Category	4
2.3 Biological Resources.....	4
2.3.1 Major Land Resource Areas	4
2.3.2 Ecological Sites.....	5
2.3.3 Vegetation Communities.....	5
2.3.4 Wildlife Resources.....	6
2.4 Special Management Areas.....	7
2.4.1 San Pedro Riparian National Conservation Area.....	7
2.4.2 Wild and Scenic Rivers.....	7
2.5 Recreation Resources, Visual Resources, and Access	8
2.6 Cultural Resources.....	8
2.6.1 Tribal Interests	9
3 Grazing Management	10
3.1 Allotment-specific Management.....	10
3.2 Current Terms and Conditions for Authorized Use	10
4 Standards and Objectives.....	12
4.1 Land Health Standards.....	12
4.2 Resource Management Plan Objectives	13
4.2.1 SPRNCA RMP	13
4.2.2 Safford District RMP	14
4.3 Allotment-specific Objectives.....	15
4.3.1 DPC Objective Methodology.....	15

- 4.3.2 Key Areas and AIM Study Plots 16
- 4.3.3 Brunckow Hill Allotment Key Area and AIM Study Plot Objectives 16
- 5 Rangeland Inventory and Monitoring methodology 20
 - 5.1 Rangeland Inventories 20
 - 5.1.1 Indicators of Rangeland Health 20
 - 5.1.2 Proper Functioning Condition Assessments for Lotic Areas 20
 - 5.2 Monitoring Protocols 21
 - 5.2.1 Assessment Inventory and Monitoring (AIM) Strategy 21
 - 5.2.2 Legacy Data Collection Methods (University of Arizona) 21
 - 5.2.3 Water Quality 22
 - 5.2.4 Actual Use 22
- 6 Management Evaluation and Summary 23
 - 6.1 Precipitation Data 23
 - 6.2 Rangeland Health Assessments 23
 - 6.2.1 Standard 1: Upland Sites 24
 - 6.2.2 Standard 2: Riparian-Wetland Sites 30
 - 6.2.3 Standard 3: Desired Resource Condition 30
- 7 Recommendations 33
 - 7.1 Recommended Management Actions 33
 - 7.1.1 Cultural Resources 33
- 8 List of Preparers 34
- 9 References 35

List of Figures

- Figure 1. State and Transition Model for Limy Upland ESD. 18
- Figure 2. State and Transition Model for Shallow Uplands (also called Granitic Upland) ESD. 19
- Figure 3. Annual rainfall totals for the allotment for the last 10 years. 23

LIST OF ACRONYMS AND ABBREVIATIONS

ADEQ	Arizona Department of Environmental Quality
AIM	Assessment Inventory and Monitoring
AUM	Animal Unit Month
BLM	Bureau of Land Management
C	“Custodial” Management Category
CFR	Code of Federal Regulations
CFU	Coliform forming unit
CWA	Clean Water Act
DPC	Desired plant community
<i>E. coli</i>	<i>Escherichia coli</i>
EPA	Environmental Protection Agency
ESD	Ecological Site Description
FBC	Full Body Contact
GLO	General Land Office
GPS	Global positioning system
Guidelines	Guidelines for Grazing Administration
HCPC	Historical climax plant community
HDMS	Heritage Data Management System
I	“Improve” Management Category
ID	Interdisciplinary
IPaC	Information for Planning and Conservation
lbs.	pounds
LHE	Land Health Evaluation
M	“Maintain” Management Category
ml	milliliter
MLRA	Major Land Resource Area
NAD	North American Datum
NRCS	Natural Resources Conservation Service
PFC	Proper Functioning Condition
P.L.	Public Law
p.z.	Precipitation zone
RMP	Resource Management Plan
RMZ	Recreation Management Zone
ROD	Record of Decision
SPRNCA	San Pedro Riparian National Conservation Area

Brunckow Hill Land Health Evaluation

Standards	Arizona Standards for Rangeland Health
TEC	Topographic Engineering Center
TFO	Tucson Field Office
U.S.C	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VRM	Visual Resource Management

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1 INTRODUCTION

The purpose of this Land Health Evaluation (LHE) report for the Brunckow Hill Allotment is to evaluate existing monitoring data against the Arizona Standards for Rangeland Health (Standards) and other site-specific objectives. An evaluation is not a decision document, but a standalone report that clearly records the analysis and interpretation of the available inventory and monitoring data. As part of the Land Health Evaluation process, allotment-specific objectives were established for the biological resources within the Brunckow Hill Allotment.

The BLM made the draft LHE available for public comment May 18-June 24, 2021. This LHE has been updated and a stand-alone final land health determination document has been signed. The final determination document identifies the causal factors for the non-achievement of land health Standards and informs the development of alternatives to make progress towards achieving Standards on the Brunckow Hill Allotment.

The Secretary of the Interior approved the Arizona Bureau of Land Management (BLM) Standards for Rangeland Health and Guidelines for Grazing Administration (Standards and Guidelines) in April 1997. The Decision Record signed by the Arizona BLM State Director (BLM 1997) provides for full implementation of the Standards and Guidelines in Arizona land-use plans. Standards and Guidelines are implemented by the BLM through the terms and conditions of grazing permits, leases, and other authorizations, grazing-related portions of activity plans, and through range improvement-related activities. The Standards are measurable and attainable goals for the desired condition of the biological resources and physical components/characteristics of desert ecosystems found within the allotment.

1.1 Definitions of Arizona Standards for Rangeland Health and Guidelines for Grazing Administration

The Standards are expressions of levels of physical and biological condition or degree of function required for healthy, sustainable rangelands and define minimum resource conditions that must be achieved and maintained. Determination of rangeland health is based upon conformance with these Standards.

Guidelines consider the type and level of grazing use. Guidelines for grazing management are types of methods and practices determined to be appropriate to ensure the Standards can be met or that significant progress can be made toward meeting the Standards. Guidelines are tools that help managers and lessees achieve Standards.

Although the process of developing Standards and Guidelines applies to grazing administration, present rangeland health is the result of the interaction of many factors in addition to grazing livestock. Other contributing factors may include, but are not limited to, past land uses, land use restrictions, recreation, wildlife, rights-of-way, wild horses and burros, mining, fire, weather, and insects and disease (Standards and Guidelines, BLM 1997).

The Arizona Standards and Guidelines identify three standards regarding (1) upland sites, (2) riparian-wetland sites, and (3) desired resource conditions based on specific indicators.

2 ALLOTMENT PROFILE AND GENERAL DESCRIPTION

2.1 Location

The Brunckow Hill Allotment is located about 5 miles northeast of the town of Sierra Vista in Cochise County, Arizona. The BLM-managed lands within the allotment comprise approximately 56% of the total livestock operation. The allotment borders the Lucky Hills allotment to the north, the Cox allotment to the south, and the San Pedro Riparian National Conservation Area (SPRNCA) to the west as shown in Appendix A: Figure A-1.

2.2 Physical Description

This section describes physical, or abiotic, characteristics of the Brunckow Hill Allotment, such as land ownership, soils, and infrastructure.

2.2.1 Surface Land Ownership

The Brunckow Hill Allotment land ownership is a mix of BLM, state, and private land (Table 1), with BLM-managed lands comprising 56% of the allotment. The BLM lands are located throughout the allotment, are partially fenced, and are used in conjunction with the private and state lands in a rotational grazing system. The BLM lands within the SPRNCA are fenced separately from the other BLM lands outside the SPRNCA within the allotment. Brunckow Hill Allotment maps are provided in Appendix A.

Table 1. Acreage of land ownership.

Land Ownership	Brunckow Hill Allotment
<i>Public Acres Inside the SPRNCA</i>	1,004
<i>Public Acres Outside the SPRNCA</i>	224
<i>Total Public Acres (inside and outside the SPRNCA)</i>	1,228
State Acres	224
Private Land Acres	741
Total Acres	2,193

2.2.2 Climate

This section describes the long-term climate for the Tombstone area using the most recent published 30-year Climate Normal data (1981-2010) from the Tombstone Cooperative Observer Program (COOP) weather station (Arguez et al. 2012). The annual rainfall Climate Normal for the 30-year period at the Tombstone site is 14.14 inches for precipitation (Table 2). The NRCS Ecological Site Descriptions used in this evaluation for reference conditions are based on a 12 to 16-inch annual precipitation zone.

Using six rain gauges in the Walnut Gulch Experimental Watershed (WGEW), Goodrich et al. (2008) found the long-term (1956-2006) average annual rainfall to be approximately 12.2 inches. Thomas and Pool (2006) computed the long-term average from 1902 to 2002 at the Tombstone Weather Station to be 13.6 inches. The slightly higher average found with the Climate Normals is due to the inclusion of above average rainfall in the late 1980's and early 1990's in the shorter time period. The established Climate Normal serves as the baseline against which more recent site-specific allotment data (found in Section 6.1) is compared.

Rainfall in Southern Arizona is typically split into two seasons: summer and winter. Summer monsoon season rainfall accounts for approximately 60% of annual rainfall totals. Summer rains fall July through

September, originate in the Gulf of Mexico, and are convective, usually brief, intense thunderstorms. This causes the rainfall to be unevenly distributed across the landscape. Even small areas separated by a relatively short distance can receive a drastically different amount of rain. Cool season moisture originates in the Pacific and Gulf of California, tends to be frontal, and falls in widespread storms with long duration and low intensity. Snow rarely lasts more than one day. May and June are the driest months of the year. Humidity is generally very low throughout the year.

Table 2. Precipitation and Temperature Averages.

Calendar Year Rainfall and Mean Temperatures per Month – NOAA 30-Year Climate Normal at Tombstone, AZ (1981-2010)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Precipitation (Inches)													Total
<i>Average</i>	1.01	0.77	0.73	0.32	0.28	0.61	2.98	3.17	1.6	0.98	0.64	1.05	14.14
Temperature (°F)													Average
<i>High</i>	59.5	62.7	68.7	76.7	85.4	93.7	92.3	89.2	87.1	78.4	67.9	59.6	76.8
<i>Low</i>	35.7	37.9	41.4	47.5	55.3	63.1	66.3	65	61.3	52.2	42.9	36.1	50.4
<i>Average</i>	47.6	50.3	55.1	62.1	70.3	78.4	79.3	77.1	74.2	65.3	55.4	47.9	63.6
Source: Arguez et al. (2012)													

The allotment is characterized by hot summers and mild winters. Data on average temperatures are also provided in Table 2. The hottest days are during June, July, and August; some days may exceed 100°F. Freezing temperatures are common at night from December-April; however, temperatures during the day are frequently above 50°F. Occasionally from December to February, temperatures may drop briefly to 0°F at night (c.f., Limy Upland Ecological Site Description [ESD] via the *Ecosystem Dynamics Interpretive Tool* [EDIT] 2020).

2.2.3 Watershed and Water Resources

The Brunckow Hill Allotment is located just east of the San Pedro River and lies within the Upper San Pedro HUC-8 Subbasin (Appendix A: Figure A-2). Within this subbasin, the allotment is included in the smaller Walnut Gulch–San Pedro River HUC-10 Watersheds.

The largest perennial drainage inside the allotment boundary is the San Pedro River, which starts in its headwaters in Mexico and reaches its terminus at the confluence with the Gila River. It has a drainage area of 1,234 square miles. In the allotment, there is a perennial reach of the San Pedro River that is 0.6 miles long. Just downstream of the allotment is the United States Geological Survey (USGS) streamgage (USGS 09471000) located at Charleston bridge. Data from this site is available on the *National Water Information System* (USGS 2019). San Pedro River baseflow is predicted to decrease into the future as a result of groundwater pumping in the basin (Pool and Dickinson 2007; Lacher 2011, 2017).

In accordance with the Clean Water Act (CWA), the Arizona Department of Environmental Quality (ADEQ) is required to produce a Section 305(b) water quality assessment and Section 303(d) listing of threatened or impaired waters in the state every 2 years. In the 2016 Water Quality in Arizona 305(b) Report, the San Pedro River within the SPRNCA boundary was assessed and determined to be impaired in the 303(d) listing (ADEQ 2016). The reach from the border of Mexico to the Charleston gage is listed as category 5, impaired, for exceedances in *Escherichia Coli* (*E. coli*), dissolved copper, and dissolved oxygen for the Full Body Contact (FBC) designated use.

2.2.4 Soils

Soil data from the Natural Resources Conservation Service (NRCS) *Web Soil Survey* were used to identify ecological sites on the Brunckow Hill Allotment. For example, based on the NRCS (2020a) *Web Soil Survey*, Brunckow-Chiricahua-Andrada complex is the most prevalent soil type. The common ecological site for this soil type is Limy Uplands. Other common soil types on the BLM portion of the Brunckow Hill Allotment are Kaboom-Reeup complex, Ubik complex, and Blakeney-Luckyhills complex (Appendix A: Figure A-5). Complete descriptions of the soil types on the Brunckow Hill Allotment are available through the online *Web Soil Survey*.

2.2.5 Range Improvements

The Brunckow Hill Allotment has seven pastures that are used in a rest-rotation grazing management strategy with some pasture and boundary fencing on BLM land. On the BLM portion of the allotment, there are three temporary stock tanks that are filled with water from a well on private land. There are four other water troughs on private land that are filled from the same private well. The only corral is on private land at the ranch headquarters. Vegetation treatments have occurred on private and state lands to reduce shrub cover and promote perennial grass growth. Appendix A: Figure A-4 shows the existing range improvements throughout the entire allotment. This mapping exercise was completed with aerial imagery and verification from the lease holder.

2.2.6 Management Category

The Management Category currently given to the Brunckow Hill Allotment is Maintain (M).

The Selective Management Category process was initiated in 1982 and was used primarily to establish priorities for investing in range improvements. Those categories include: Improve (I), Maintain (M), and Custodial (C).

Category I: Allotments where current livestock grazing management or level of use on public land is, or is expected to be, a significant causal factor in the non-achievement of land health standards or where a change in mandatory terms and conditions in the grazing authorization is or may be necessary. When identifying Category I allotments, review condition of critical habitat, conflicts with sage-grouse, and whether projects have been proposed specifically for implementing the Healthy Lands Initiative.

Category M: Allotments where land health standards are met or where livestock grazing on public land is not a significant causal factor for not meeting the Standards and current livestock management is in conformance with guidelines developed by the State Directors in consultation with Resource Advisory Councils. Allotments where an evaluation of land health standards has not been completed, but existing monitoring data indicates that resource conditions are satisfactory.

Category C: Allotments where public lands produce less than 10% of the forage in the allotment or are less than 10% of the land area. An allotment should generally not be designated Category C if the public land in the allotment contains: 1) critical habitat for a threatened or endangered species, 2) wetlands negatively affected by livestock grazing.

2.3 Biological Resources

2.3.1 Major Land Resource Areas

Major Land Resource Areas (MLRA) are geographically associated land resource units, usually encompassing several thousand acres. Soil scientists with NRCS in appropriate geographic states wrote the descriptions of MLRAs and are responsible for describing new MLRAs and/or adjusting the

boundaries of existing MLRAs. A MLRA may be one continuous area or several separate nearby areas. MLRAs are characterized by patterns of soils, geology, climate, water resources, and land use. The Brunckow Hill Allotment is in MLRA 41—Southeastern Arizona Basin and Range, which makes up about 15,730 square miles. MLRAs are further broken down into ecological sites, which are associated units of soil and vegetation with quantifiable characteristics.

2.3.2 Ecological Sites

An ecological site is a distinctive kind of land that is unique in its ability to produce a distinctive kind and amount of vegetation. The soils, hydrology, and vegetation within an ecological site are the product of many environmental, biotic, and abiotic factors, which are described in the Ecological Site Description (ESD) as established by the NRCS. Ecological sites are named/classified based on soil parent material or soil texture and precipitation and provide a consistent framework for classifying and delineating land units that share similar capabilities to respond to management activities or disturbance. State and transition models in the ESD describe multiple plant community states and the natural range of variability within those states that may result from activities and disturbances, such as land use, vegetation management, climate change, and spread of invasive species. The NRCS also produces reference sheets for many ecological sites that detail the natural variability in rangeland health indicators. ESDs and reference sheets were accessed online through the *Ecosystem Dynamics Interpretive Tool* (EDIT 2020).

Soil map units were used to help identify ecological sites in the Brunckow Hill Allotment. Most soil map units are comprised of two or more ecological sites. For example, a soil map unit described as “Clayey Swale 90%, Loamy Swale 10%” refers to the approximate proportion of each ecological site found in a particular soil map unit. In other words, 90% of the unit is Clayey Swale ecological site and 10% of the unit is Loamy Swale ecological site. These are also referred to as blended sites. Ecological site maps for the Brunckow Hill Allotment (Appendix A: Figure A-7) are generalized to larger scales and on the ground ecological site identification and verification is necessary in determining the correct ESD and reference sheet. There are four ecological sites in the Brunckow Hill Allotment (Appendix A: Figure A-7) and more details on pertinent ecological sites are presented in Section 4.3.

2.3.3 Vegetation Communities

Table 3 below lists the vegetation communities within the Brunckow Hill Allotment, with the individual vegetation community acreages separated by whether they fall inside or outside the SPRNCA boundary. Specific vegetation community acreages are shown for the SPRNCA because these acreages tie to SPRNCA RMP vegetation objectives. They are also shown in Appendix A: Figure A-8. Chihuahuan Desertscrub is the primary vegetation community for the allotment, comprising 79% of the total acreage of the allotment. The data source for lands outside the SPRNCA is Landfire. Data on BLM-managed land inside the SPRNCA is a combination of data from the U.S. Army Topographic Engineering Center (TEC) (2001), Southwest Regional Gap Analysis Project, and ESDs. The data source on non-BLM lands within the allotment is U.S. Army TEC (2001).

Table 3. Vegetation communities in the Brunckow Hill Allotment.

Vegetation Community	Inside NCA		Outside NCA		Total	
	Acres	Percent Area	Acres	Percent Area	Acres	Percent Area
Chihuahuan Desertscrub	1,021	47	718	33	1,739	79
Cottonwood/Willow	13	1	5	<1	18	1
Desert Washes (Xeric Riparian)	24	1	0	0	24	1
Developed	1	<1	1	<1	2	<1
Mesquite Bosque	28	1	0	0	28	1
Other	3	<1	0	0	3	<1

Vegetation Community	Inside NCA		Outside NCA		Total	
	Acres	Percent Area	Acres	Percent Area	Acres	Percent Area
Sacaton Grassland	4	<1	0	0	4	<1
Semidesert Grassland	7	<1	365	17	373	17
Water	1	<1	0	0	1	<1
TOTAL	1,104	50	1,089	50	2,193	100

Dominant Vegetation Community Descriptions

Described below are select dominant or important vegetation communities whose acreages were obtained from the above data sets.

Chihuahuan Desertscrub

Dominant shrub species are whitethorn acacia, tarbush, and creosote bush. Other shrubs present are mariola, desert sumac, and mesquite. Bush muhly and threeawn grasses are common perennial grasses. Other important plant species are ocotillo, soap tree yucca, and Palmer’s century plant. These species all provide nectar for migrating birds and certain bat species.

Semidesert Grassland

Semidesert grassland once covered vast areas of the San Pedro River Valley, where now only remnants remain (Latta et al. 1999). This habitat is now associated with drainages in the Chihuahuan Desertscrub. Native perennial grasses may include sideoats grama, blue grama, vine mesquite grass, tobosa grass, cane beardgrass, Arizona cottontop, and threeawn grasses. Lehmann lovegrass (*Eragrostis lehmanniana*), a non-native perennial grass, can also be common in this community, particularly in the Limy and Granitic Upland (Shallow Upland) ecological sites (EDIT 2020).

Fremont Cottonwood-Gooding’s Willow Forest

The two dominant tree species in this community are Fremont cottonwood and Goodling’s willow, but the community is also composed of a variety of mesic tree species endemic to the southwest (e.g., seep willow, arroyo willow, Arizona ash, Arizona black walnut, netleaf hackberry, and velvet mesquite). Herbaceous vegetation, such as deer grass, scratch grass, horsetail, giant sacaton, and spike rush, occur in the understory. High diversity and productivity in these riparian forests make them focal points for fish and wildlife habitat and a priority habitat for the BLM. Most of this community type is on private land in the Brunckow Hill Allotment. The condition of the Fremont cottonwood-Gooding’s willow forest on the allotment is described by the Proper Functioning Conditioning (PFC) Assessment found in Section 6.2.2.

Mesquite Bosque

Mesquite bosques are characterized as dense stands of velvet mesquite trees that rely on groundwater depths of less than 50 feet. Mesquite forests, or bosques, historically represented one of the most abundant riparian communities in the southwestern U.S. but are now reduced to remnant status (Stromberg et al. 1993). There are 28 acres of mesquite bosque in the Brunckow Hill Allotment that are also inside the SPRNCA boundary (see Table 3).

2.3.4 Wildlife Resources

General Wildlife

The expected wildlife species composition on the allotment is characteristic of the Madrean Basin and Range province in southeastern Arizona. Possible common species include, but are not limited to, mule deer, Couse white-tailed deer, mountain lion, coyote, bobcat, raccoon, skunk, white-throated woodrat, white-footed mouse, a variety of bats, gopher snake, king snake, western diamondback rattlesnake, coachwhip, patch-nosed snake, western whiptail lizard, side-blotched lizard, and tree lizard.

Migratory bird species that utilize the area include, but are not limited to, red-tailed hawk, Cooper's hawk, bald eagle, golden eagle, American peregrine falcon, raven, turkey vulture, meadowlark, ladder-back woodpecker, ash-throated flycatcher, and a wide variety of small passerine birds. No surveys have been conducted specifically within this allotment for this project to determine presence, however these species have the potential to occur within the vegetation communities located on this allotment (Appendix A: A-8). The allotment is both within and adjacent to the SPRNCA, which encompasses the SPRNCA Important Bird Area, an area designated for the value it holds for native birds.

Livestock may impact wildlife in a variety of ways, by their presence, through behavioral disturbance, and through competition for forage. Behavioral impacts resulting from inter-specific encounters (including human and livestock) are difficult to quantify as they vary by species and by type of interaction. Wildlife currently present on the allotment have, to varying degrees, acclimated to the presence of livestock and associated human disturbances.

Special Status Species

U.S. Fish and Wildlife Service (USFWS) *Information for Planning and Conservation (IPaC)* (USFWS 2020) and Arizona Game and Fish Department (AGFD) *Heritage Data Management System (HDMS)* (AGFD 2020) online databases show that 12 federally threatened or endangered species, 19 migratory birds protected under the Migratory Bird Treaty Act, and eight BLM sensitive species could occur within the Brunckow Hill Allotment boundary as well as within a 5-mile buffer (see species lists in Appendix B). In addition, yellow-billed cuckoo and Huachuca water umbel have proposed critical habitat within the allotment boundary.

2.4 Special Management Areas

2.4.1 San Pedro Riparian National Conservation Area

The SPRNCA is in Cochise County, Arizona, south of Benson and west of Tombstone and Bisbee, Arizona (Appendix A: Figure A-1). It starts at the US-Mexico border and runs north-south for approximately 47 miles, encompassing 55,990 acres of federal lands administered by the BLM's Tucson Field Office (TFO). Congress designated the SPRNCA as the nation's first riparian National Conservation Area on November 18, 1988, through Public Law (P.L.) 100-696. The SPRNCA contains four of the rarest habitats in the southwest, a rich diversity of plants and animals, and a number of nationally significant paleontological and cultural sites. The enabling legislation recognizes these, and other characteristics, as conservation values to be conserved, protected, and enhanced in perpetuity.

The Brunckow Hill Allotment includes approximately 1,004 acres of public land in the SPRNCA and 224 acres outside the SPRNCA.

2.4.2 Wild and Scenic Rivers

The allotment includes approximately 0.6 miles of the San Pedro River Wild, Scenic and Recreational Study River and approximately 200 acres of the study river corridor (118 acres of BLM and 82 acres of private land). The Study River was analyzed during the RMP development process and was found eligible and suitable for addition to the National Rivers System with a 'Recreational' classification. It is under protective management to ensure its free-flowing condition, water quality, tentative classification, and Outstandingly Remarkable Values are maintained as described in the SPRNCA RMP (BLM 2019). The protective management measures only apply to BLM land.

2.5 Recreation Resources, Visual Resources, and Access

The BLM lands in the Brunckow Hill Allotment provide opportunities for dispersed recreational use in undeveloped settings. The Charleston Road corridor in the SPRNCA is under a Rural Recreation Management Zone (RMZ), and the rest of the allotment in the SPRNCA is under a Back Country RMZ, with motorized access planned for the part of the upland area in the SPRNCA. The RMZs identify recreation management objectives for recreational access and activities, and the recreational setting as described in the SPRNCA RMP (BLM 2019). There are no specific recreation management objectives for the part of the allotment outside the SPRNCA. Typical recreation activities in the area include sightseeing, viewing the river, birding, viewing historic sites, hunting, and hiking. There are no developed recreation sites in the allotment and no maintained trails. The Charleston parking recreation site is adjacent to the allotment and provides access to the section of the river in the allotment. The existing network of paths, historic mining exploration roads, and other roads on the allotment provide non-motorized public access from Charleston Road and Brunckow Road. Significant features that attract public use include the San Pedro River, the San Pedro Trail, the historic Charleston and Millville townsites, Brunckow Cabin, and the historic steel trestle bridge. These features provide interpretive and educational opportunities about the natural and cultural heritage of the area.

The Brunckow Hill Allotment is part of the scenery viewed by the public in the foreground along Charleston Road, the existing recreation sites at the Charleston parking area and Millville Trailhead, and the local segments of the San Pedro Trail. The BLM land along the river is under Visual Resource Management (VRM) Class II to preserve the character of the landscape and the land in the upland hills is under VRM Class III to allow management activities and partially preserve the character of the landscape. Range improvements that involve construction of improvements or facilities (clearing, earthwork, structures, roads, tanks, etc.) should be designed to blend in with the surrounding landscape.

Public access to BLM lands in the allotment is mainly from Charleston Road and Brunckow Road, via existing paths, historic mining roads, and utility access roads that are closed to public vehicle use. Brunckow Road is under a right-of-way across state land held by a private party but it is available for public access to the BLM land. The closed roads are in primitive condition and are used for non-motorized public access.

2.6 Cultural Resources

The BLM's evaluation of Arizona Standards for Rangeland Health includes considerations for the protection and conservation of cultural resources—such as prehistoric and historic-age sites, buildings, and structures—in addition to plants and other resources with potential cultural significance to Native American tribes. Should the BLM identify impacts to cultural heritage sites or traditional-use resources, revised lease terms and conditions may be warranted, and rangeland management directives could be modified to achieve desired resource conditions. Section 6.2 describes the BLM's assessment efforts regarding cultural and traditional-use resources within the Brunckow Hill Allotment.

A BLM cultural resources specialist completed a comprehensive Class 1 (existing information) assessment of the subject allotment between February 20 and March 16, 2020. Data reviewed were obtained from BLM cultural program project files, site reports, and atlases, in addition to BLM-maintained General Land Office (GLO) plats and patent records. Electronic files were also reviewed using online cultural resource databases including *AZSite* (2020), Arizona's statewide cultural resource inventory system, and the *National Register of Historic Places NPGallery Digital Asset Search* (2020). Archival information was compared with livestock grazing and range improvement data to determine the potential for resource conflicts, particularly in livestock concentration areas such as around water sources, at

chutes/corrals, and near supplemental feeding locations. The results of archival research are summarized as follows; data provided are applicable to BLM-administered lands within the Brunckow Hill Allotment (i.e., the jurisdictional Area of Potential Effect [APE]) and based on currently available information from the aforementioned sources.

Background research identified six prior cultural resources investigations (Table 4) that, collectively, have inventoried approximately 1,128 acres of BLM-managed surface and documented eight cultural resource sites. Known site types include prehistoric resource procurement, processing, seasonal camp, and rock art sites, as well as historic-age mining/prospecting sites, habitations/camps, and a railroad alignment.

Table 4. Prior Cultural Resources Investigations within the Brunckow Hill Allotment.

No	Project No.	Project Name	Reference(s)
1	1968-1.ASM	Charleston Dam Survey	Kayser n.d.
2	1985-213.ASM	AEPCO San Rafael Project	Dosh et al. 1987
3	BLM-060-85-15	BLM Survey	AZSite 2020
4	BLM-060-88-23	BLM Survey	AZSite 2020
5	BLM-060-91-3	BLM Survey	AZSite 2020
6	BLM-060-97-19	BLM Survey	AZSite 2020

Historic-age GLO plat maps also were reviewed that depict a network of roads, houses, a shaft, hoists, an “open cut”, “Old Workings [at] Bronckow Mine”, telegraph and telephone lines, a pipeline, several mining claims, and the Arizona and Southeastern Railroad, (plat nos. 2453 and 2454, dated 1903 and 1910, respectively). Although none of these mapped features correspond with range improvements or livestock concentration areas on BLM-managed surface, historic-age land-use features may exist throughout the subject allotment. Such features serve as evidence of the long history of grazing and mining activities within the allotment and surrounding vicinity, much of which predates the early 1900’s. Many of these features have likely been removed, repurposed, or substantially modified over time for those uses.

One particular site of note is Brunckow’s Cabin: the adobe ruins of a late 1850’s mining claim and habitation that later earned the moniker of the “bloodiest cabin in Arizona history.” The site is a known popular tourist destination along the SPRNCA; however, it is only accessible to the public by foot. Vehicular access is administrative use only and both the adobe ruin and old mine shaft are fenced.

2.6.1 Tribal Interests

The BLM is consulting with nine Native American tribes who claim cultural affiliation to and/or traditional use of the area as determined through the online *Arizona Government-to-Government Consultation Toolkit* (2020). Identified tribes for consultation initiation include the Fort Sill Apache Tribe, Hopi Tribe, Mescalero Apache Tribe, Pascua Yaqui Tribe, Tohono O’odham Nation, San Carlos Apache Tribe, White Mountain Apache Tribe, Yavapai-Apache Nation, and Zuni Tribe. One plant species, velvet mesquite (*Prosopis velutina*), was identified as having potential cultural significance (NRCS 2020b).

Currently, there are no known adverse impacts to any culturally significant plants, items, sites, or landscapes. If new information is provided by consulting tribes, additional or edited terms and conditions of land-use or mitigation may be required to protect or restore resource values.

3 GRAZING MANAGEMENT

The Brunckow Hill Allotment has a long history of livestock grazing, predating the establishment of the SPRNCA or the BLM. Cochise County remains one of the top two livestock producing counties in Arizona, and Tombstone was a historic livestock market (Collins 1996). The ranching operation and ranch headquarters located on private property on the Brunckow Hill Allotment has been within the same family since the late 1800’s. The Brunckow Hill Allotment has been leased for livestock grazing by the same lessee since 1963. Traditionally, the lessee has run 20 cattle as a cow-calf operation on the entire allotment (on BLM and state-leased lands, and private land). The following section discusses the allotment-specific management, permitted use, and terms and conditions on the current lease for the Brunckow Hill Allotment.

3.1 Allotment-specific Management

The Brunckow Hill Allotment consists of 2,193 acres of BLM, state, and private lands used in a 7-pasture, yearlong, rest-rotation livestock grazing system. The lessee uses variables such as rainfall pattern, pasture readiness, and use of private land irrigated pastures to determine where the livestock should be placed at any given time. The BLM lands within the allotment comprise approximately 56% of the total acreage (see Table 1). The 84 Animal Unit Months (AUMs) under the BLM grazing lease are included in the total head of cattle (20) on the private land and state lease and are managed together on the entire allotment.

3.2 Current Terms and Conditions for Authorized Use

Current grazing use on the Brunckow Hill Allotment is in accordance with the terms and conditions of the current lease issued for 84 AUMs on public lands. The Mandatory Terms and Conditions of the lease are listed in Table 5.

Table 5. Mandatory Terms and Conditions of the existing lease.

Total Livestock on the BLM acres of the Allotment	Livestock Kind	Grazing Period of Use	Percent Public Land*	Type Use	AUMs on Public Land
7	Cattle	3/1 to 2/28	100	Active	84

* Percent Public Land is used for calculating AUMs on the BLM-managed acreage. This is not stating the percent of public land within the total allotment.

Existing Other Terms and Conditions

1. In order to improve livestock distribution on the public lands, all salt blocks and/or mineral supplements will not be placed within a ¼ mile of any riparian area, wetland meadow, or watering facility (either permanent or temporary) unless stipulated through a written agreement or decision in accordance with 43 CFR 4130.3-2(c).
2. If, in connection with operations under this authorization, any human remains, funerary objects, or sacred objects of cultural patrimony as defined in the Native American Graves Protection and Repatriation Act (P.L. 101-601; 104 Stat. 3048; 25 U.S.C. 3001) are discovered, the permittee/lessee shall stop operations in the immediate area of the discovery, protect the remains and objects, and immediately notify the Authorized Officer of the discovery. The permittee/lessee shall continue to protect the immediate area of the discovery until notified by the Program Manager that operations may resume.

3. In accordance with 43 CFR 4130.8-1(F), failure to pay grazing bills within 15 days of the due date specified in the bill shall result in a late fee assessment of \$25.00 or 10 percent of the grazing bill, whichever is greater, but not to exceed \$250.00. Payment made later than 15 days after the due date shall include the appropriate late fee assessment. Failure to make payment within 30 days may be a violation of 43 CFR Secs. 4150.1 and 4160.1-2.

4 STANDARDS AND OBJECTIVES

Arizona Rangeland Health Standards 1, 2, and 3 are applicable to all BLM lands in Arizona. The BLM is required to evaluate the Standards on lands that contain livestock grazing on them as part of the LHE process. Standard 3 requires the development of Desired Plant Community (DPC) objectives that tier to the relevant RMPs. Because the Brunckow Hill Allotment covers lands inside and outside of the SPRNCA, both the SPRNCA RMP (BLM 2019) and the Safford District RMP (BLM 1994) apply to the respective portions of these lands. Section 4.2 lists the relevant SPRNCA RMP (BLM 2019) objectives that the required DPC objectives must tier to and Section 4.3 goes on to describe the allotment-specific DPC objectives.

4.1 Land Health Standards

This section describes the Arizona Standards for Rangeland Health and the criteria for meeting each standard. The following descriptions are taken directly from the “Arizona Standards for Rangeland Health and Guidelines for Grazing Administration” (BLM 1997).

Standard 1: Upland Sites

“Upland soils exhibit infiltration, permeability, and erosion rates that are appropriate to soil type, climate and landform (ecological site).”

Criteria for meeting Standard 1:

- Soil conditions support proper functioning of hydrologic, energy, and nutrient cycles. Many factors interact to maintain stable soils and healthy soil conditions including appropriate amounts of vegetative cover, litter, soil porosity, and organic matter. Under proper functioning conditions, rates of soil loss and infiltration are consistent with the potential of the site.
- Ground cover in the form of plants, litter, or rock is present in pattern, kind, and amount sufficient to prevent accelerated erosion for the ecological site; or ground cover is increasing as determined by monitoring over an established period of time.
- Signs of accelerated erosion are minimal or diminishing for the ecological site as determined by monitoring over an established period of time.

Standard 2: Riparian-Wetland Sites

“Riparian-wetland areas are in proper functioning condition.”

Criteria for meeting Standard 2:

- Stream channel morphology and functions are appropriate for proper functioning condition for existing climate, landform, and channel reach characteristics. Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows.
- Riparian-wetland functioning condition assessments are based on examination of hydrologic, vegetative, soil and erosion-deposition factors. The BLM has developed a standard checklist to address these factors and make functional assessments. Riparian-wetland areas are functioning properly as indicated by the results of the appropriate checklist application.

Standard 3: Desired Resource Conditions

“Productive and diverse upland and riparian-wetland plant communities of native species exist and are maintained.”

Criteria for meeting Standard 3:

- Upland and riparian-wetland plant communities meet DPC objectives. Plant community objectives are determined with consideration for all multiple uses. Objectives also address native species, and the requirements of the Taylor Grazing Act, Federal Land Policy and Management Act, Endangered Species Act, CWA, and appropriate laws, regulations, and policies.
- Desired Plant Community objectives will be developed to assure that soil conditions and ecosystem function described in Standards 1 and 2 are met. They detail a site-specific plant community, which when obtained, will assure rangeland health, State water quality standards, and habitat for endangered, threatened, and sensitive species. Thus, DPC objectives will be used as an indicator of ecosystem function and rangeland health.

Desired Plant Community Objectives

DPC objectives are established for important biological resources. The DPC objectives for the Brunckow Hill Allotment have quantifiable indicators that 1) ensure the natural diversity and abundance of native vegetation occurs as expected for the ecological site and 2) density, vigor, cover, and species richness of native perennial grass, shrub, and forb species are maintained or enhanced based on the ecological site potential. The Brunckow Hill Allotment DPC objectives tie directly back to the broader SPRNCA RMP (BLM 2019) objectives to ensure that the requirements of P.L. 100-696 are being met. The objectives address resource conditions based on vegetation attributes, such as composition, structure, and cover, that are desired within the allotments. The DPC objectives for each site were based on current resource reference conditions and overall site potential as defined in the NRCS ESDs (EDIT 2020).

4.2 Resource Management Plan Objectives

4.2.1 SPRNCA RMP

This section outlines applicable SPRNCA RMP (BLM 2019) resource objectives that are applicable to the Brunckow Hill Allotment.

Meeting Standard 3 of the Arizona Standards for Rangeland Health is contingent upon the following SPRNCA RMP objective because one of the guidelines to meet this Standard is to “maintain, restore, or enhance water quality in conformance with State or Federal Standards”:

Water Resource Objectives (SPRNCA RMP ROD, p. 2-3):

- **ob-WAT-1:** Reduce or prevent contamination of surface and groundwater by nonpoint source pollution to meet State requirements.

Standard 3 depends on meeting the DPC objectives in Section 4.3. Those DPC objectives must tier to the following SPRNCA RMP objectives:

All Vegetation Community Objectives (SPRNCA RMP ROD, p. 2-4):

- **ob-VEG-ALL-1:** Ensure that the natural diversity and abundance of native vegetation occurs as expected for landform and ecological sites.
- **ob-VEG-ALL-2:** Maintain or improve the ecological processes and function of habitats that support priority or special status plant species.

Upland Vegetation Resource Objectives (SPRNCA RMP ROD, p. 2-7):

- **ob-VEG-UP-1:** Manage 1,028 acres of upland vegetation toward restoring the perennial native grass component to address shrub encroachment.
- **ob-VEG-UP-2:** In the grassland vegetation community, maintain or enhance density, vigor, cover, and species richness of native perennial grass, shrub, and forb species based on ecological site potential.
- **ob-VEG-UP-3:** In the Chihuahuan Desertscrub vegetation community, increase native annual and perennial herbaceous plants based on ecological site potential.

Riparian Vegetation Resource Objectives (SPRNCA RMP ROD, p. 2-6):

- **ob-VEG-RIP-3:** Provide sufficient vegetated bank cover to prevent erosion, slow down water, and improve bank soil condition including porosity for recharge.

Fish, Wildlife, and Special Status Species (SPRNCA RMP ROD, p. 2-8):

- **ob-WILD-1:** Conserve, protect, and enhance wildlife and aquatic resources in accordance with the aquatic, wildlife, scientific, cultural, educational, and recreational values of the SPRNCA.
- **ob-WILD-2:** Restore and maintain habitat of suitable quality and quantity to support identified priority fish and wildlife species.
- **ob-WILD-5:** Manage springs for priority wildlife habitat.
- **ob-WILD-6:** Conserve, protect, and enhance desert washes with adequate cover and width while considering habitat connectivity and adequate patch size.

Livestock Grazing Objectives (SPRNCA RMP ROD, p. 2-15):

- **ob-GRAZ-2:** Maintain productive, diverse upland, riparian, and wetland plant communities of native species.
- **ob-GRAZ-3:** Ensure utilization of current year's growth on upland native perennial grass does not exceed 40 percent at the allotment scale, except for targeted grazing treatments.

4.2.2 Safford District RMP

This section outlines applicable Safford District RMP (BLM 1994) resource objectives. The Safford District RMP objectives are applicable to lands in the Brunckow Hill Allotment that are outside of the SPRNCA.

Wildlife Habitat Objectives (Safford District Proposed RMP, p. 33):

- Maintain and enhance priority species (see Safford District RMP for the list of priority species) and their habitats.
- Manage priority wildlife species habitat (vegetation communities) or special features of that habitat (water, riparian vegetation, cliffs, etc.) to maintain or enhance population levels.
- Focus management efforts on enhancing biological diversity.

Soil Erosion (Safford District Proposed RMP, p. 44):

- Reduce accelerated erosion.

Vegetation (Safford District Proposed RMP, p. 45):

- The objective for management of upland vegetation is to restore and maintain plant communities for wildlife, watershed condition, and livestock. The DPCs will be determined in the preparation of activity plans.

4.3 Allotment-specific Objectives

The Brunckow Hill Allotment-specific objectives are the DPC Objectives. This section describes the DPC objectives and provides detailed rationale on how they align with the relevant RMP objectives. The RMP vegetation objectives are directly related to ecological site potential thus the DPC objectives tie to the historic climax plant community (HCPC). In general, DPC objectives were developed based on site potential as described in the ESDs, site-specific monitoring data, professional judgement, and wildlife habitat requirements.

The DPC objectives developed in this LHE are supportive of wildlife objectives and priority species enhancement as described in the SPRNCA RMP (BLM 2019). Specifically, grassland birds, mule deer, and lesser long-nosed bats would benefit. Upland sites adjacent to riparian areas also support riparian species as wildlife move throughout the landscape for necessary resources. Attainment of the DPC objectives helps meet the RMP objectives ob-WILD-1, 2, and 3 as described in Section 4.2.1 and directly benefit all priority species listed in the RMP for upland sites noted in ama-WILD-1 (BLM 2019).

The DPC objectives will maintain perennial grass and shrub cover that is supportive of wildlife habitat. An appropriate amount of perennial grass cover is necessary for nesting and protection of ground nesting birds, such as Gambel's and scaled quail, lesser nighthawk, greater roadrunner, grasshopper sparrow, and Botteri's sparrow. Reptiles such as ornate box turtle and northern Mexican gartersnake benefit from adequate perennial grass cover because of thermal and predator protection. A wide variety of small mammals such as white-throated woodrat, cactus mouse, banner-tailed kangaroo rat, and pocket gopher also use perennial grasses for protection and forage.

4.3.1 DPC Objective Methodology

The ESDs describe expected amounts of cover for various plant functional/structural groups, such as shrubs and perennial grasses. However, there is a small, noteworthy discrepancy in how the BLM's Assessment, Inventory, and Monitoring (AIM) protocol collects vegetative cover and how the ESD reports vegetative cover. The AIM protocol collects foliar cover, which is the percentage of ground covered (if the sun were directly overhead) by the vertical projection of the aerial portion of plants. Small openings in the canopy and intraspecific overlap are excluded in foliar cover. However, ESDs and corresponding reference sheets report expected canopy cover, which is defined as the percentage of the ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included with canopy cover (NRCS 2003). Foliar cover is always less than canopy cover and the sum of all species cover for canopy or foliar cover may exceed 100% (NRCS 2003).

Given the discrepancy between canopy cover and foliar cover, the BLM relied heavily on the 2019 and 2020 AIM foliar cover data to establish DPC objectives. After two more years of AIM data collection at key areas and at the un-grazed reference sites (see description below), key area foliar cover objectives will be

updated to reflect an average of three years of AIM data. The BLM will seek to utilize a working group¹ who would review AIM data and provide input on updated objectives. Updated objectives, along with the associated rationale, will be posted on the ePlanning website.

There are some minor differences in the methodology that the BLM used to develop DPC perennial grass foliar cover objectives. For Limy Uplands, the BLM used the perennial grass key species bush muhly (*Muhlenbergia porteri*) to establish DPC objectives because bush muhly is a deep-rooted perennial grass that prevents erosion more effectively than shallow-rooted perennial grasses such as fluff grass (*Dasyochloa pulchella*), which also occurs on Limy Uplands. The other dominant ecological sites on the Brunckow Hill Allotment support a variety of deep-rooted perennial grass species and thus it was not necessary to base those DPC objectives on one key perennial grass species.

The more abundant Limy Upland and Shallow Upland ecological sites are present on un-grazed portions of BLM lands in the SPRNCA and were used as reference sites to determine perennial grass and shrub foliar cover potential specific to the area. In addition, using these un-grazed reference sites allowed for direct comparison of foliar cover which is not available using ESDs. The BLM collected foliar cover at four Limy Upland and two Shallow Upland reference sites in fall 2019 and fall 2020 to help establish realistic site-specific objectives. The BLM used the reference data, in addition to the Limy Uplands and Shallow Uplands state and transition models, to establish the associated DPC objectives.

4.3.2 Key Areas and AIM Study Plots

The DPC objectives are established at key areas. In grazing administration, a key area is defined as a relatively small portion of a range selected because of its location, use, or value as a monitoring location for grazing use. Key areas are indicator areas that can reflect the overall conditions at larger scales, such as a pasture, grazing allotment, wildlife habitat area, herd management area, watershed area, etc. Key areas are usually non-randomly selected but can be randomly generated locations. In contrast, an AIM study plot, for the purposes of this LHE, is a randomly generated monitoring location where AIM data is collected, and rangeland health indicators are assessed. An AIM study plot is sometimes not representative of a larger area because they are random and might fall close to disturbances, such as a road or watering location. However, AIM study plots in combination with key areas help paint a clearer picture of land health. The AIM data analyzed in this LHE were collected at both key areas and AIM study plots in 2019. Details on data collection methods and information gathered at key areas and AIM study plots are presented in Chapter 5.

4.3.3 Brunckow Hill Allotment Key Area and AIM Study Plot Objectives

The two most common ecological sites in the BLM-managed portion of the Brunckow Hill Allotment are Shallow Upland and Limy Upland (Appendix A: Figure A-7). There is one key area (BK-01) on Shallow Upland and one key area (BK-023) and one AIM study plot (GRZ-01) on Limy Upland (Table 6 and Appendix A: Figure A-5 through A-7). All three monitoring locations are within the SPRNCA. Key area BK-01 was established by the BLM and University of Arizona Extension in 2012 and pace frequency, cover, dry weight rank, and fetch data were collected intermittently from 2012-2017 using protocols described in Appendix B.

¹ A working group would be comprised of technical experts for the applicable resource area such as wildlife, vegetation, and soils who review monitoring data and provide input. A working group would be composed of representatives from other federal, state, and local agencies and organizations who have specific technical expertise and qualifications.

Table 6. Ecological site, location, and protocols established on the Brunckow Hill Allotment key areas and AIM study plot.

Name	Type	Ecological Site	Ecological Site ID	GPS Coordinates (Lat., Lon.)	Year data was collected	Protocol
BK-023	Key Area	Limy Upland 12-16"	R041XC309AZ	31.6415404, -110.1517665	2019	AIM, IIRH*
BK-01	Key Area	Shallow Upland 12-16"	R041XC322AZ	31.6299843, -110.1532391	2012, 2013, 2014, 2015, 2016, 2017	Pace frequency, cover, dry weight rank, and fetch
					2019	AIM, IIRH
GRZ-01	AIM Study Plot	Limy Upland 12-16"	R041XC309AZ	31.621164, -110.176928	2019	AIM, IIRH

*Interpreting Indicators of Rangeland Health (IIRH)

Site-specific DPC objectives for the Brunckow Hill Allotment are identified below.

Key Area BK-023 DPC Objectives for Limy Upland 12-16" Precipitation Zone Ecological Site

- Perennial grass foliar cover of ≥2%
- Shrub foliar cover <30%

Rationale for establishment of Limy Upland DPC objectives:

The ESD for Limy Uplands identifies a potential of >5% canopy cover of perennial grass (labelled as MUPO [bush muhly] and ARIST [threeawn]) and <45% canopy cover of shrubs (labelled as LATR [creosote] and ACCO [whitethorn acacia]) in its historical climax plant community (HCPC) state (Figure 1). The Limy Upland key area BK-023 is currently in the desired HCPC state (“Native shrub, grass, and forb”) with perennial grass foliar cover of 2% and shrub foliar cover of 38.6% in 2019. Reference data collected at four nearby un-grazed Limy Upland sites on the SPRNCA, including AIM study plot GRZ-01, show foliar cover between 0-1% and 22-62% for perennial grasses and shrubs, respectively (Appendix D: Table D-22 through D-25). These data more accurately reflect Limy Upland perennial grass and shrub foliar cover potential specific to the area. However, given that the perennial grass foliar cover at the Limy Upland key area BK-023 exceeds that of the reference sites, the objective is to maintain 2019 foliar cover levels of the key perennial grass species bush muhly (*Muhlenbergia porteri*). Bush muhly is the primary perennial grass species found at BK-023 and is listed in the ESD as a key perennial grass species for Limy Uplands as it helps prevent erosion. Maintaining bush muhly cover levels will keep Limy Uplands in the desired “Native shrub, grass, forb” HCPC state (Figure 1). Although shrubs are the expected dominant functional/structural group on Limy Uplands, maintaining the objective of <30% shrub foliar cover would maintain an open shrub canopy appropriate for site potential.

The Limy Upland site BK-023 DPC objectives support wildlife and priority species enhancement objectives described in the SPRNCA RMP (2019) by maintaining perennial grass and reducing shrub cover as described in Section 4.3.1.

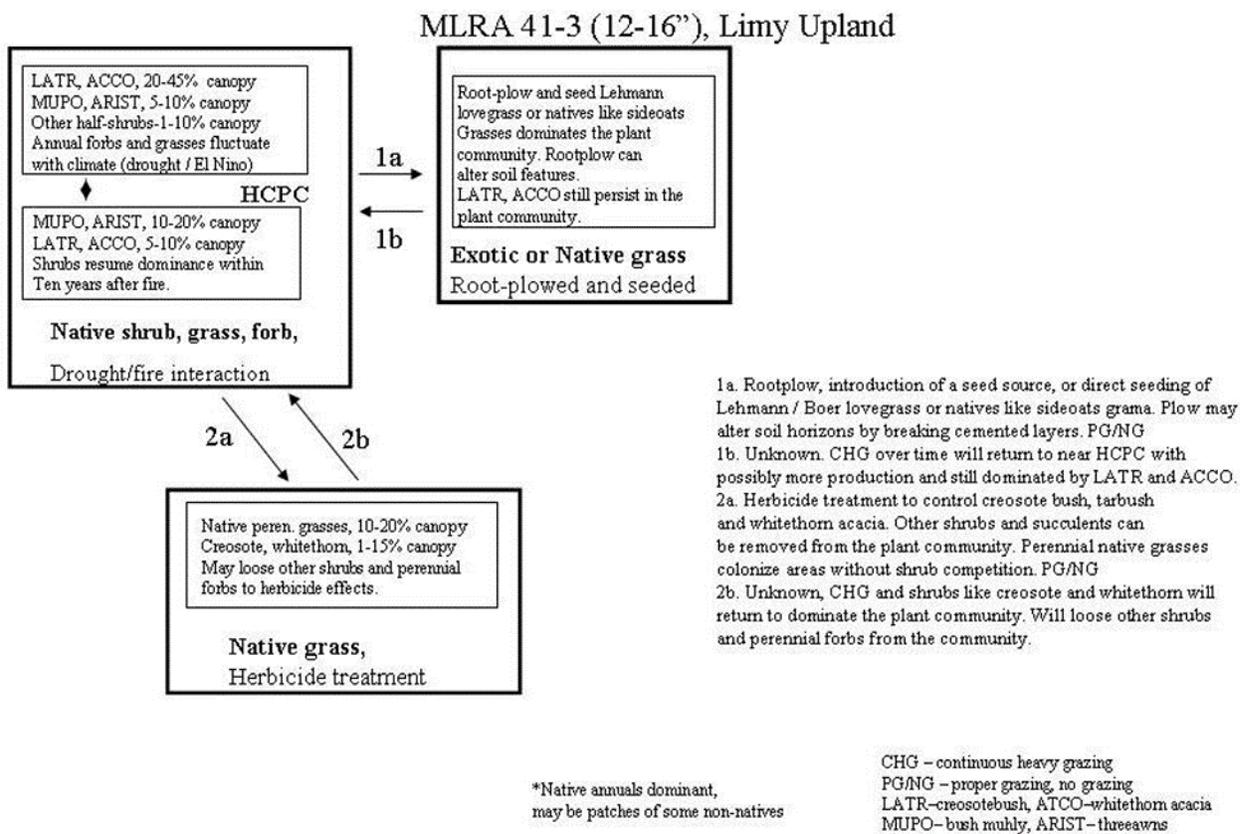


Figure 1. State and Transition Model for Limy Upland ESD.

Key Area BK-01 DPC Objectives for Shallow Upland 12-16'' Precipitation Zone Ecological Site

- Perennial grass foliar cover of ≥20%
- Shrub foliar cover <10%

Rationale for establishment of Shallow Upland DPC objectives:

The ESD for Shallow Uplands identifies a potential of 20-35% canopy cover of perennial grass and <10% canopy cover of shrubs in its HCPC state (Figure 2). The Shallow Upland key area BK-01 is currently in the “Native grass, forb, half shrub” HCPC state moving toward a more shrub dominated state with 12.7% perennial grass foliar cover and 36% shrub foliar cover. Reference data collected at two nearby un-grazed Shallow Upland reference sites on the SPRNCA show perennial grass foliar cover between 25-39% and shrub foliar cover between 24-25% (Appendix D: Tables D-26 and D-27). These reference site data show a similar natural range of variability, expressed in foliar cover, to the expected canopy cover in the ESD (Figure 2) therefore 20% perennial grass foliar cover is within the range expected for the Shallow Uplands HCPC. The shrub foliar cover objective of <10% would prevent the site from moving into the “Shrub Increase” state and would create an open shrub canopy appropriate for site potential.

The Shallow Upland DPC objectives support wildlife and priority species enhancement objectives described in the SPRNCA RMP (BLM 2019) by increasing perennial grass and reducing shrub cover. In addition to the benefits to species described in Section 4.3.1, species of economic importance, such as

mule deer, white-tail deer, javelina, and a variety of predatory fur-bearing mammals, are more likely to rely on Shallow Upland habitat due to the relatively greater forage production and cover.

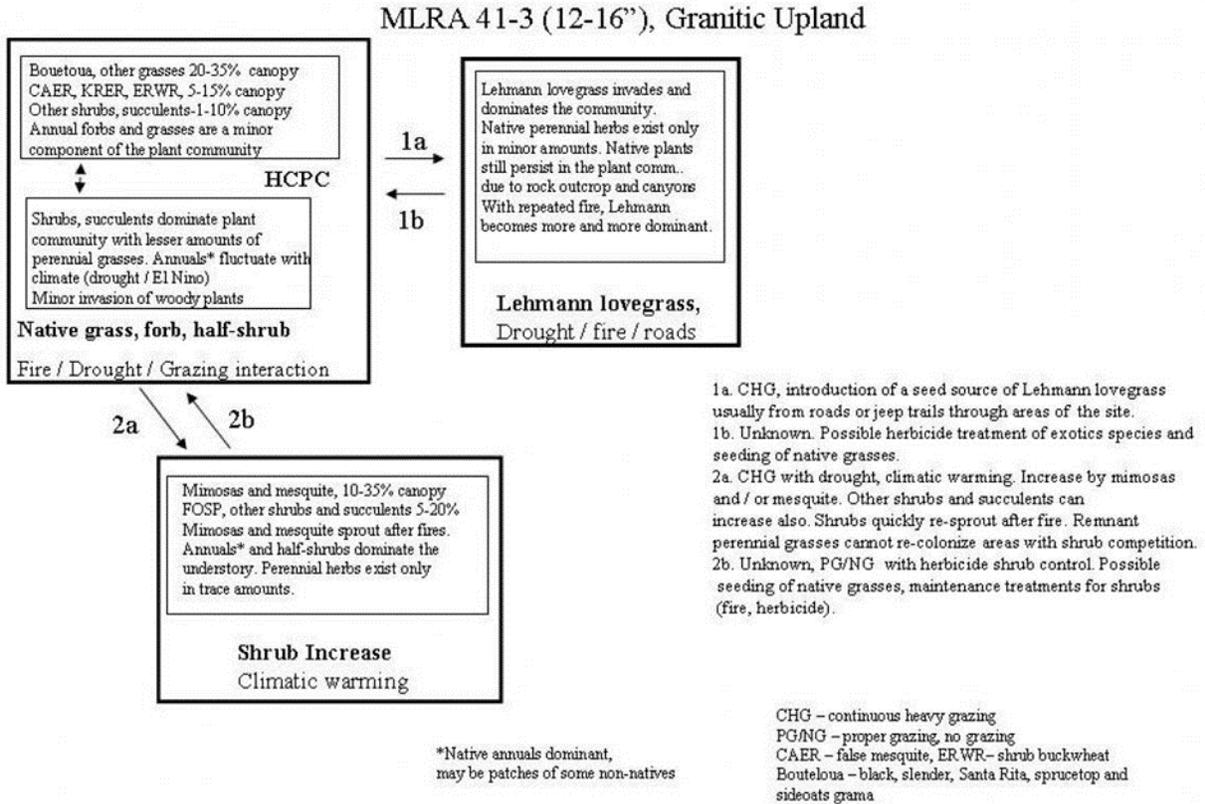


Figure 2. State and Transition Model for Shallow Uplands (also called Granitic Upland) ESD.

5 RANGELAND INVENTORY AND MONITORING METHODOLOGY

This section describes the protocols used by BLM to conduct current inventory and monitoring. Historic monitoring protocols are provided in Appendix C for additional information.

5.1 Rangeland Inventories

The following protocols describe qualitative assessments of land health in upland and riparian settings.

5.1.1 Indicators of Rangeland Health

The protocol Interpreting Indicators of Rangeland Health (IIRH) (Pellant et al. 2020) was used to help evaluate Standards 1 and 3. During the IIRH process, 17 indicators of three rangeland health attributes are assessed: soil and site stability, hydrologic function, and biotic integrity. The BLM uses this protocol to assess the presence or absence, quantity, and distribution of multiple components of a system. By using this qualitative, observational procedure, the functional status of rangeland indicators can be assessed and used to guide future management.

This LHE evaluates the three rangeland health attributes and provides information on the functioning of ecological processes (water cycle, energy flow, and nutrient cycle) relative to the reference state for the ecological site. The IIRH assessments are a snapshot of the status of the rangeland attributes at key areas and AIM study plots at the time of the site evaluation.

Attribute ratings reflect the degree of departure from expected levels for each indicator per the ESD reference sheet. The degree of departure may be categorized (rated) as:

- None to Slight
- Slight to Moderate
- Moderate
- Moderate to Extreme
- Extreme to Total

5.1.2 Proper Functioning Condition Assessments for Lotic Areas

The Proper Functioning Condition (PFC) Assessment for Lotic Areas protocol was used to evaluate Standard 2. A PFC assessment is intended to qualitatively determine the overall physical function of a stream segment's riparian area and complex set of natural processes. The PFC assessment is not designed to be a quantitative monitoring tool, but a qualitative tool completed by an interdisciplinary (ID) team that provides a snapshot assessment of conditions on the ground. The PFC procedure for lotic (flowing) water, such as a stream, is fully described in Dickard et al. (2015). The following is a brief overview of the PFC assessment protocol that was used in this LHE to document the condition of the stream and riparian resources along the San Pedro River.

A PFC assessment is an inventory of 17 indicators which are categorized into three groups of questions relating to either hydrologic, vegetative, or geomorphic features of the stream or river reach being assessed. The hydrologic indicators relate to floodplain connectivity, channel dimensions, and lateral extent of the riparian area. The vegetative indicators relate to stream and riparian function (e.g., plant age-class diversity, distribution, and vigor). The geomorphic indicators highlight the presence of erosional or depositional features found in the field and how they relate to the current state and ability of the stream to function with the supplied sediment and flow from the watershed.

Under the PFC protocol, stream reaches can be categorized as:

- Proper Functioning Condition (PFC)
- Functional – At Risk (FAR) (Trend: Upward, Downward, Not Apparent)
- Nonfunctional
- Unknown

5.2 Monitoring Protocols

Quantitative data is also used to assess Standards 1, 2, and 3. The following monitoring protocols describe the type of monitoring data collected at key areas and AIM study plots and used in this LHE.

5.2.1 Assessment Inventory and Monitoring (AIM) Strategy

The AIM strategy provides a framework for the BLM to inventory, monitor, and quantitatively assess the condition and trend of natural resources on public lands and is used to evaluate Standards 1 and 3 in this LHE. The standardized terrestrial data measurements (or indicators) collected with the AIM protocol include bare ground (soil not covered by plant foliar cover or any of the ground cover categories), species-specific foliar cover, species-specific basal cover, ground cover (rock fragment, biological soil crust, and litter), species diversity, vegetation height, plant canopy gaps, soil texture, and soil stability. In addition, plot characterization information is collected, such as slope, aspect, landscape position, ecological site identification, and noted at the time of data collection. AIM indicator data are used in the IIRH assessments for each monitoring location. Key area repeat monitoring data will be collected using the AIM protocol. Additional information regarding the BLM's AIM strategy can be accessed online through the *AIM Landscape Toolbox* (BLM 2020).

5.2.2 Legacy Data Collection Methods (University of Arizona)

Prior to using the AIM strategy, the BLM collected monitoring data with the University of Arizona using the protocols found in Appendix C.

Ground Cover

Ground cover is the amount of surface area comprised of bare ground, perennial plant bases, litter, gravel, or rocks. Ground cover data, each soil protection category expressed as a percentage of total hits, reflect the amount of litter, vegetative root bases, gravel, and rocks available to intercept raindrop impact before reaching the soil and of bare ground exposed to climatic elements. Ground cover data are collected with each quadrat placement. A single point from the quadrat is consistently the focal point for cover category classification.

Pace Frequency

Pace frequency is the number of times a plant species is present within a given number of uniformly sized sample quadrats (plot frames placed repeatedly across a stand of vegetation). Plant frequency is expressed as percent presence for each species encountered within total number of quadrat placements, therefore, frequency reflects the probability of encountering a particular plant species within a specifically sized area (quadrat size) at any location within the key area. The total number of frequency hits among all species will not equal the total number of quadrat placements and frequency is insensitive to the size or number of individual plants. Frequency is a very useful monitoring method but does not express species composition, only species presence. Frequency is an index that integrates species' density and spatial patterns.

5.2.3 Water Quality

Water quality data used in this assessment are collected by the regulatory authority (i.e., ADEQ) or associated volunteers. The sampling and testing are done in accordance with ADEQ and Environmental Protection Agency (EPA) approved methodologies for *E. coli* using the Colilert system (Jones 2018). The water quality monitoring data is used to help inform evaluation of Standard 3.

5.2.4 Actual Use

Actual use was determined from billed use, which has been paid at full use since 1992. Allowable AUMs are calculated on BLM-administered land only. Lease holders are billed for their maximum use available on public lands unless non-use is requested and approved. Non-use by the lessee was not requested during the evaluation period.

6 MANAGEMENT EVALUATION AND SUMMARY

6.1 Precipitation Data

Rainfall data from 2010 to 2020 was gathered from 3 gauges (rain gauges: 418, 20, 411) surrounding the allotment boundary. No rain gauge exists inside the allotment. This data is collected by the Agricultural Research Service Southwest Watershed Research Center, made available through Data Access Project (Goodrich et al. 2008). The graph below (Figure 3) displays the average of the 3 gauges for each year as well as the maximum and minimum values for annual rainfall. It also includes the 30-year Climate Normal from the Tombstone gauge (see Section 2.3.2). Only four of the last 10 years are close to (within 1 inch) or greater than the previous 30-year normal for annual rainfall totals.

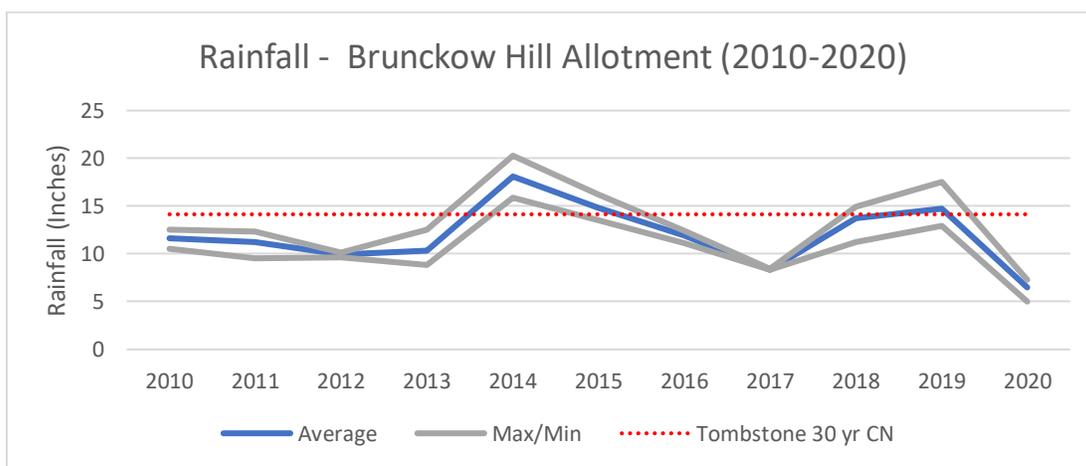


Figure 3. Annual rainfall totals for the allotment for the last 10 years.

6.2 Rangeland Health Assessments

In addition to AIM data, documents and publications used in the assessment process include the *Web Soil Survey* (NRCS 2020a), ESDs for MLRA 41 (NRCS 2006), *Interpreting Indicators of Rangeland Health Technical Reference 1734-6* (Pellant et al. 2020), *The Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems* (Herrick et al. 2005), *Sampling Vegetation Attributes Technical Reference 1734-4* (Coulloudon et al. 1999), and the *National Range and Pasture Handbook* (NRCS 2003). All reference materials are available online or at the BLM TFO for public review.

Comprehensive AIM data tables, IIRH assessment data sheets, and photographs of key areas and AIM study plots used in this analysis are in Appendix D. Table 7 is a summary of the degree of departure of soil and site stability, hydrologic function, and biotic integrity at all monitoring locations on the Brunckow Hill Allotment (refer to Table 6 for monitoring locations; maps provided in Appendix A: Figures A-5 through A-7). All locations are within the SPRNCA.

Table 7. Summary of Interpreting Indicators of Rangeland Health attribute ratings.

Key Area	Ecological Site	Range Health Attributes – Degree of Departure		
		Soil and Site Stability	Hydrologic Function	Biotic Integrity
BK-01	Shallow Upland 12-16"	Slight to Moderate	Slight to Moderate	Slight to Moderate
BK-023	Limy Upland 12-16"	Moderate	Moderate	Slight to Moderate
GRZ-01 AIM Study Plot	Limy Upland 12-16"	Slight to Moderate	Slight to Moderate	Slight to Moderate

6.2.1 Standard 1: Upland Sites

This section describes the results of the IIRH assessments and AIM data used as they apply to Standard 1 at each key area and AIM study plot.

Standard 1 of the Arizona Standards for Rangeland Health is:

- *Upland soils exhibit infiltration, permeability, and erosion rates that are appropriate to soil type, climate and landform (ecological site).*

Shallow Uplands Site **BK-01**

Key area BK-01 (Tables 8-11) is in the Shallow Uplands 12-16" p.z. ecological site. The Shallow Uplands ecological site potential plant community is warm season perennial grass dominant and shrub sub-dominant. Perennial forbs and annual grasses and forbs are a minor component on this site. All major perennial grasses and shrubs are expected to be well dispersed throughout the plant community. Common plant species include grama grasses (*Bouteloua spp.*), curly mesquite grass (*Hilaria belangeri*), and fairy duster (*Calliandra eriophylla*). Most common plant species can re-sprout and recover quickly after disturbances such as drought and fire. This site occurs in the middle elevations of the Madrean Basin and Range province in southeastern Arizona, southwestern New Mexico, as well as Chihuahua and Sonora, Mexico on gently sloping to moderately steep pediments which flank mountain areas. Small rock outcroppings can be common on Shallow Uplands (EDIT 2020).

Key Area **BK-01**

Table 8. Key area BK-01 AIM data compared to Shallow Upland ESD.

	Basal Cover				Biological Crust	Litter	Surface Fragments ¼" - 3"	Surface Fragments > 3"	Bedrock	Bare Ground
	Grass	Forb	Shrub	Tree						
ESD R041XC322AZ	3-10%	0-1%	3-5%	0-1%	0-1%	15-50%	25-65%	0-10%	1-10%	5-50%
BK-01	0.7%	0%	0%	0%	0.7%	51.3%	30.7%	0%	0%	14%

BK-01 Rangeland Health Attribute 1: Soil and Site Stability

The overall rating for the soil and site stability attribute at BK-01 was Slight to Moderate departure from ecological site potential. Eight indicators of soil and site stability were rated None to Slight departure from reference condition. Indicator 1 (number and extent of rills) was at a Slight to Moderate departure and Indicator 5 (number and extent of gullies) was rated Moderate departure. No rills or gullies are expected for the site; however, both were observed at the site. The rills observed on the site were not abundant and were not likely transporting significant amounts of soil off the site due to the vegetation growing on the sides and bottom. The only gully present had vegetation on most banks with no head cutting. The slope (17%) and nearby historic mining operations may have contributed to the gully formation.

BK-01 Rangeland Health Attribute 2: Hydrologic Function

The overall rating for the hydrologic function attribute at BK-01 was a Slight to Moderate departure from ecological site potential. Seven indicators of hydrologic function were rated as None to Slight departure because they were within the natural range of variability expected for the ecological site. Indicator 1 (number and extent of rills) was Slight to Moderate departure and Indicator 5 (number and extent of gullies) was ranked as Moderate departure. The rills and gully at the site are likely reducing some of the water infiltration capacity, causing water to move offsite, however they are not abundant and are re-vegetating. Indicator 10 (plant community composition and distribution relative to infiltration) was rated Slight to Moderate departure due to the lower-than-expected perennial grass cover and the higher-than-expected shrub cover. Perennial grasses promote the entry of water into the soil through the creation of root macropores, intercept rainfall, and slow overland flow. The site had an appropriate amount of litter cover, slowing overland water flow and dissipating energy that could cause erosion.

BK-01 Rangeland Health Attribute 3: Biotic Integrity

Table 9. Functional Group AIM foliar cover data at BK-01.

Functional Group	Foliar Cover %
Shrub	36.0
Perennial Grass	12.7
Forb	4.7

The overall rating for biotic integrity at BK-01 was a Slight to Moderate departure from ecological site potential. Five indicators for biotic function were rated as None to Slight departure because they were within the natural range of variability expected for the site. Indicator 15 (expected annual production), Indicator 16 (invasive plants), and Indicator 17 (plant vigor and reproductive capability) were rated Slight to Moderate departure and Indicator 12 (plant functional groups) was rated Moderate departure. There was good cover of perennial grass on the site, however shrubs had become co-dominant (Table 9), which led to a Slight to Moderate departure from reference state. Less-than-expected annual production and reduced vigor and growth of vegetation were observed at the site. Mesquite and Lehmann lovegrass—considered invasive under reference conditions—were scattered throughout the site.

The BLM pace frequency data at BK-01 from 2012-2016 can be used to look at past trends while the AIM data establishes a new baseline. Tables 10 and 11 show pace frequency transect ground cover and percent frequency of shrub canopy and key perennial grasses at BK-01 from 2012-2016.

Table 10. Pace frequency transect ground cover data collected at BK-01 from 2012-2016.

Percent Ground Cover	5/1/12	7/26/13	5/1/14	9/4/14	9/9/15	5/18/16	11/3/16
Bare Ground	4%	3%	4%	3%	2%	5%	8%
Litter	43%	50%	41%	60%	47%	43%	50%
Live Basal Veg	1%	2%	1%	1%	1%	4%	3%
Rock Fragment	53%	44%	54%	36%	50%	49%	40%

Though not directly comparable with AIM, the pace frequency ground cover at BK-01 shows similar results as the 2019 AIM data with relatively high litter and rock fragment cover. The pace frequency data show litter was always greater than 40%, rock fragment cover ranged from 36-53%, and bare ground was always less than 10% from 2012-2016. These data show that appropriate ground cover has remained constant at BK-01 with some of the variation attributed to changes in annual weather, timing of monitoring, and small differences in the exact location of the line that was paced at the time of data collection.

Table 11. Pace frequency transect shrub and perennial grass key species data at BK-01.

Percent Frequency	5/1/12	7/26/13	5/1/14	9/4/14	9/9/15	5/18/16	11/3/16
Shrub Canopy	66%	51%	82%	53%	98%	43%	66%
Black grama	4%	0%	0%	2%	4%	5%	4%
Side oats	1%	2%	0%	1%	2%	1%	3%
Lehmann lovegrass	45%	4%	7%	4%	73%	43%	51%
Bush muhly	0%	0%	0%	3%	5%	8%	7%

Past pace frequency data showed between 43-98% frequency of shrub canopy. This indicates that the site has had high shrub cover since at least 2012. From 2012-2016, black grama was 2-5% frequency, side oats grama was 1-3% frequency, Lehmann lovegrass drastically varied from 4-73% frequency, and bush muhly (first recorded in 2014) was 3-8% frequency. Overall, perennial grass frequency – especially Lehmann lovegrass – varied at BK-01. Production data collected in 2017 at BK-01 estimated 277 lbs./acre of grass and 271 lbs./acre of woody plants, which is within the range expected under low precipitation in Shallow Uplands.

Conclusions for Shallow Upland Site BK-01

All three attributes of rangeland health (soil and site stability, hydrologic function, and biotic integrity) were rated at a Slight to Moderate departure from the Shallow Uplands ecological site potential. This rating is based on the presence of erosional features (rills and gullies) and changes in plant community composition away from a perennial grass-dominated state. Although erosional features exist on the site, they appear to be re-vegetating and not transporting a significant amount of soil off the site. Adequate litter and rock fragment cover promote soil stabilization and water permeability within the site. Additionally, bare ground percent and soil surface stability values are within their expected ranges for the site. Vegetation cover data indicates that the site is now in a shrub-encroached state with shrubs having the greatest cover. Adequate perennial grass cover and vigor is important for water capture and storage on site as well as forage and cover for cattle and wildlife. While the perennial grasses are less than what would be optimal for this ecological site, the biotic integrity of the site, as well as the hydrologic function and soil stability, are functioning at a Slight to Moderate departure from reference condition.

Limy Upland Sites GRZ-01 and BK-023

AIM study plot GRZ-01 (Tables 12 and 13) and key area BK-023 (Tables 14 and 15) are in the Limy Uplands 12-16" p.z. ecological site. Limy Uplands occur in the middle elevations of the Madrean Basin and Range province in southeastern Arizona on pediments, fan terraces, and hillslopes. The expected reference condition and potential plant community for Limy Uplands is a diverse mixture of desert shrubs, half shrubs, perennial grasses, and forbs (listed in order of dominance). Common plant species for this ecological site include creosote bush (*Larrea tridentata*), whitethorn acacia (*Vachellia constricta*), bush muhly (*Muhlenbergia porteri*), and threeawn (*Aristida* spp.). Most of the major perennial grasses are expected to be well dispersed throughout the plant community. Cryptogam cover (moss, lichen) can be considerable in the plant community but diminishes as the surface cover of gravel increases (EDIT 2020).

AIM study plot GRZ-01

GRZ-01 is an AIM study plot and not a key area because of its proximity to Charleston Road and a powerline.

Table 12. AIM study plot GRZ-01 data compared to Limy Upland ESD.

	Basal Cover				Biological Crust	Litter	Surface Fragments ¼" - 3"	Surface Fragments > 3"	Bedrock	Bare Ground
	Grass	Forb	Shrub	Tree						
ESD R041XC309AZ	1-3%	0-1%	2-3%	0%	1-25%	10-20%	5-45%	0-8%	0-1%	15-55%
GRZ-01	0%	0%	2%	0%	0%	22.9%	71.8%	0%	0%	6.1%

GRZ-01 Rangeland Health Attribute 1: Soil and Site Stability

The overall rating for soil and site stability at GRZ-01 was a Slight to Moderate departure from reference condition. Seven indicators for soil site stability were rated as None to Slight departure because they were within the natural range of variability for the Limy Upland ecological site. The site exhibited appropriate amounts of bare ground and rock, litter, and vegetative cover. Indicator 5 (gullies) and Indicator 9 (soil surface structure and organic matter content) were rated Slight to Moderate departure and Indicator 8 (soil surface resistance to erosion) was rated Moderate departure. Gullies had vegetation on most banks with no head cutting, however no gullies are expected for the site. Steep slopes likely contributed to gully formation. Pedestals are expected on shrubs for this ecological site, but some pedestals appeared to be more recent and taller than expected, indicating soil loss. Soil surface resistance to erosion was rated as Moderate due to low soil stability tests results under plant canopies. Soil stability is measured at 16 locations throughout an AIM plot and measured on a scale of 1-6, with 6 being the most stable. Values of 4-6 are expected under plant canopies for the Limy Upland site and 1.6 was the average value measured under canopies at GRZ-01.

GRZ-01 Rangeland Health Attribute 2: Hydrologic Function

The overall rating for hydrologic function at GRZ-01 was a Slight to Moderate departure from reference condition. Six indicators for hydrologic function were rated as None to Slight departure because they were

within the natural range of variability for the site. Indicator 5 (gullies) and Indicator 9 (soil surface structure and organic matter content) were rated Slight to Moderate departure and Indicator 8 (soil surface resistance to erosion) and Indicator 10 (plant community composition and distribution relative to infiltration and runoff) were rated as Moderate departure. Gullies are likely reducing water retention at the site but appeared to be healing with vegetation on most banks and no active head cuts. The lack of perennial grasses and plant basal cover is also impacting the water holding capacity at the site. Perennial grasses are expected to be sub-dominant at the site and AIM data shows 0% cover. Signs of soil surface loss were observed, and soil surface stability measurements were lower than expected (described above in the previous section). Lack of organic matter at the soil surface will increase run-off and soil loss and reduce resistance to erosion, however, the high rock fragment cover (72%) and sandy soil surface slow overland water flow and promote infiltration at GRZ-01. In addition, no severe erosional features, such as sheet erosion, were observed at the site.

GRZ-01 Rangeland Health Attribute 3: Biotic Integrity

Table 13. Functional group AIM foliar cover data at GRZ-01.

Functional Group	Foliar Cover %
Shrub	55.6
Perennial Grass	0.0
Forb	4.0
Sub-shrub	1.3

The overall rating for biotic integrity at GRZ-01 was Slight to Moderate departure from reference condition. Seven indicators for biotic function were rated as None to Slight departure because they were within the natural range of variability for the ecological site. Indicator 9 (soil surface structure and organic matter content) was rated Slight to Moderate departure and Indicator 8 (soil surface resistance to erosion) was rated as Moderate departure.

Key Area BK-023

Table 14. Key area BK-023 AIM data compared to Limy Upland ESD.

	Basal Cover				Biological Crust	Litter	Surface Fragments ¼" - 3"	Surface Fragments > 3"	Bedrock	Bare Ground
	Grass	Forb	Shrub	Tree						
ESD R041XC309AZ	1-3%	0-1%	2-3%	0%	1-25%	10-20%	5-45%	0-8%	0-1%	15-55%
BK-023	0%	0%	0%	0%	0%	18%	39.3%	0%	0%	31.3%

BK-023- Rangeland Health Attribute 1: Soil and Site Stability

The overall rating for soil and site stability at BK-023 was Moderate departure from reference condition. Five indicators for soil site stability were rated as None to Slight departure because they were within the natural range of variability for the Limy Uplands ecological site. Indicator 8 (soil surface resistance to erosion) and Indicator 9 (soil surface structure and organic matter content) were rated Slight to Moderate departure, Indicator 2 (water flow patterns) and Indicator 5 (gullies) were rated as Moderate departure, and Indicator 1 (rills) was rated Moderate to Extreme departure. Rills and gullies are not expected under reference conditions and the assessment team observed rills that were long and deep (1-2' in depth, 5-6'

wide). Gullies exhibited active erosion with vegetation on the sides, but little vegetation growing in the bottom. A bedrock layer appeared to be helping arrest further incision of the gullies. Soil stability test values were lower than expected. Values of 1-3 and 4-6 are expected in open areas and under plant canopies, respectively, and averages of 1.1 in open areas and 2.2 under shrubs were observed. Signs of soil surface loss and degradation in interspaces was observed at the site. Water flow patterns were common and continuous ($\geq 100'$) with litter accumulation in areas with recent active flow. Rock fragment cover (39.3%) and litter cover (18%) are helping to stabilize the soil and prevent erosion.

BK-023 Rangeland Health Attribute 2: Hydrologic Function

The overall rating for hydrologic function was Moderate departure from reference condition. Four indicators for hydrologic function were rated as None to Slight departure because they were within the natural range of variability for the site. Indicator 8 (soil surface resistance to erosion), Indicator 9 (soil surface structure and organic matter content), and Indicator 10 (plant community composition relative to infiltration) were rated Slight to Moderate departure, Indicator 2 (water flow patterns) and Indicator 5 (gullies) were rated as Moderate departure, and Indicator 1 (rills) was rated Moderate to Extreme departure. Erosional features, such as rills, water flow patterns, and gullies, transport water off site. The high cover of rock fragment (39.3%) helps dissipate energy during rainfall events, but the site would greatly benefit from increased perennial grass cover and a reduction in shrubs to promote infiltration and reduce water concentrating in flow paths, rills, and gullies.

BK-023 Rangeland Health Attribute 3: Biotic Integrity

Table 15. Functional group AIM foliar cover data at BK-023.

Functional Group	Foliar Cover %
Shrub	38.6
Perennial Grass	2.0
Forb	0.0

The overall rating for the biotic integrity attribute at BK-023 was Slight to Moderate departure from reference condition. Four indicators for biotic function were rated as None to Slight departure because they were within the natural range of variability of the site. Indicator 8 (soil surface resistance to erosion), Indicator 9 (soil surface structure and organic matter content), Indicator 13 (dead or dying plant parts), Indicator 15 (annual production), and Indicator 17 (plant vigor with an emphasis on reproduction) were rated Slight to Moderate departure. Standing dead litter was measured at 10.8% across the BK-023 AIM plot. In addition, reduced plant vigor and seed production and lower-than-expected annual production were observed on the site, which could have been a result of the major rainfall events in 2019 taking place outside of the normal growing season (major rainfall events in 2019 took place in February, September, and November).

Conclusions for Limy Upland Sites GRZ-01 and BK-023

GRZ-01 had all three attributes of rangeland health (soil and site stability, hydrologic function, and biotic integrity) rated at a Slight to Moderate departure from the Limy Uplands ecological site potential. The main concerns with the site are the presence of gullies, reduced stability and organic content of the soil surface, and lack of perennial grasses. Departure from reference conditions for Indicators 8 and 9 signals that there may not be adequate soil organic matter and soil microorganisms to promote litter decomposition and perennial grass germination and recruitment at the site. Perennial grasses promote infiltration and are an important component for wildlife and livestock habitat and forage. The species inventory at GRZ-01 noted four perennial grasses, indicating that those species are likely present in the soil seed bank if a shrub or erosion control treatment were to occur. In addition, the shrub, rock fragment,

and litter cover provide protection against wind erosion and help prevent runoff. It should be noted that GRZ-01 is located on the west side of the San Pedro River where the lessee does not currently run cattle.

Key area BK-023 soil and site stability and hydrologic function attributes were rated as Moderate departure and the biotic integrity attribute was rated at Slight to Moderate departure from the Limy Uplands ecological site potential. Soil loss and deposition from water flow paths, rills, and gullies being present and active were a main concern for the site. Biotic integrity is lacking because native perennial grasses only account for 2% of foliar cover while whitethorn and creosote account for 30% cover, reducing infiltration. The causes of the indicator departures are due to many factors, but the proximity to a developed road, visual evidence of historic mining in the area, and prolonged drought are likely key contributing factors.

6.2.2 Standard 2: Riparian-Wetland Sites

This section describes the results of the PFC assessment as it applies to Standard 2.

Standard 2 of the Arizona Standards for Rangeland Health is:

- *Riparian-wetland areas are in properly functioning condition.*

The Brunckow Hill Allotment includes 0.6 miles of the San Pedro River just upstream of the Charleston gage. This stream reach (Number 7 in Stromberg et al. 2006; Reach E in NRST 2012) is also known as the Charleston reach. It is naturally confined by the Charleston Hills, resulting in a narrow river valley with room for only small areas of floodplain adjacent to the river. According to Stromberg et al. (2006), the reach inside the allotment boundary is rated as condition class 3 which has perennial or near-perennial streamflow (>99% streamflow permanence) and shallow, stable alluvial groundwater. At potential, vegetation communities that are characteristic of perennial flow should be expected. In the reach, confinement of post-entrenchment surfaces by shallow bedrock is a limitation for storage of floodwaters that would benefit downstream reaches. In addition, the survival and expansion of hydric herbaceous communities described for the active channel of perennial reaches depends on continued and sustained discharge from the regional groundwater flow system.

In 2012, the reach that includes this portion of the river in the allotment was rated to be in proper functioning condition (PFC) as assessed by the National Riparian Service Team (see PFC field sheet, Appendix C). A more recent PFC assessment was not completed. The livestock operator does not graze the riparian reach or pasture and has not for the past 30 years. In this reach, recruitment of very young cottonwood seedlings (1-3 years) was observed near the channel in several locations (root sprouts were observed upstream). Other vegetation, including bulrush, showed clear signs of expansion along the active channel and banks. There is the opportunity for continuing improvement of vegetation and narrowing of active channel over time as the riparian area expands inward. However, in its current state, the reach will likely retain its dimension, pattern, and profile through moderately high flood events. The single form channel and lack of excessive mid-channel bars also indicates that the river is processing sediment provided from tributaries.

6.2.3 Standard 3: Desired Resource Condition

Standard 3 of the Arizona Standards for Rangeland Health is:

- *Productive and diverse upland and riparian-wetland plant communities of native species exist and are maintained.*

In addition, Standard 3 requires the development of quantitative allotment-specific objectives that tier from the RMP objectives. The Brunckow Hill Allotment-specific objectives are the DPC objectives described in Section 4.3. Section 4.3 also describes how the DPC objectives support the SPRNCA RMP (BLM 2019) objectives. The following tables show the DPC objectives for the Brunckow Hill Allotment compared to the AIM monitoring data collected in 2019 and whether the objective is being met. Additional description and rationale for Standard 3 is provided in Section 7.3. Furthermore, water quality is a criterion under Standard 3, therefore the SPRNCA RMP objective for water quality (BLM 2019: ob-wat-01) in Section 4.2 is considered under this standard.

Shallow Uplands

Key Area BK-01

Objective	KA BK-01 monitoring result	Conclusion
Perennial grass foliar cover of $\geq 20\%$	12.7% perennial grass foliar cover	Not Achieved
Shrub foliar cover $< 10\%$	36% shrub foliar cover	Not Achieved

Limy Uplands

AIM study plot GRZ-01

Objective	AIM study plot GRZ-01 monitoring result	Conclusion
Perennial grass foliar cover of $\geq 2\%$	0% perennial grass foliar cover	Not Achieved
Shrub foliar cover $< 30\%$	55.6% shrub foliar cover	Not Achieved

Key Area BK-023

Objective	KA BK-023 monitoring result	Conclusion
Perennial grass foliar cover of $\geq 2\%$	2% perennial grass foliar cover	Achieved
Shrub foliar cover $< 30\%$	38.6% shrub foliar cover	Not Achieved

Water Quality

The pollutant of most concern for this LHE is *E. coli*. Livestock, humans, and wildlife are all sources of *E. coli* that can contaminate surface water. In an analysis of bovine and human DNA markers on water samples with high amounts of *E. coli* in the Upper San Pedro Basin, bovine source presence was greater compared to human sources (Rock et al. 2018). Livestock fecal deposits (i.e., cow pies) can enter streams in two ways: by direct deposit into the stream (or nearby moist soils) or by transportation from uplands in runoff from rain events. Considering this first mechanism, the water quality at baseflow conditions (typical flow outside of rainfall driven floods) in the perennial reach of the stream is directly influenced by nearby livestock, in this case the livestock in the grazing allotment (Gary et al. 1983, Line 2003, Sunohara et al. 2012). During runoff-inducing rainfall events (flood flows), the fecal bacteria in cow pies can be transported into the soil and into downstream waterways (Thelin and Gifford 1983, Doran and Linn 1979, Jawson et al. 1982, Muirhead et al. 2005, Stocker et al. 2015).

As noted in Section 2.3.3, the applicable designated use for the reach of the San Pedro River is Full Body Contact (FBC). The water quality criteria for the FBC use for *E. coli* is a maximum of 410 coliform forming units (CFU) per 100 milliliter (ml) sample or a geometric mean of greater than 126 CFU per 100ml sample

(A.A.C. R18-11-109). A water body is not meeting the criteria if there are two or more exceedances in the last 3 years of sampling. As noted in Section 4.2, the water quality objectives of the SPRNCA RMP (BLM 2019) are to meet or make progress towards meeting state standards.

Water quality samples were taken by ADEQ and trained volunteers at Charleston Bridge which is just downstream of the reach of the river that is in the allotment. This data is available from the *Water Quality Portal* (USGS 2020). Of the 21 aggregated samples taken in the last 3 years of available data (2017-2019), there are three samples at this site that exceed the single sample maximum (>410 CFU /100 ml). Each of these exceedances occurred during or relatively soon after a flood flow event. Samples taken further upstream at the State Route 90 bridge during the same sample days also showed exceedances. This indicates that although possible sources exist in the allotment there are also sources in the upper parts of the watershed that are providing substantial contributions to these *E. coli* exceedances.

Part of the allotment drains to the San Pedro River below the Charleston Bridge sampling sites and sampling at a location downstream of this confluence (near Boston Mill) is limited to two samples for this site taken during the same 3-year period. They follow a similar trend that is found at the Charleston gage, with non-exceedance during baseflows and exceedances during flood flows. The high background levels of *E. coli* in the watersheds of the San Pedro River (Coronado RC&D 2013) and in the sediment beds of perennial waterways (Pachepsky and Shelton 2011) make it difficult to ascertain the source of the *E. coli* levels in flood flow events. Without additional sampling and analysis, it is difficult to determine with confidence the impact of livestock use within the BLM portion of the allotment on these exceedances during flood flow events.

7 RECOMMENDATIONS

The following section represents recommendations identified through the LHE process.

7.1 Recommended Management Actions

Based on the results of the above evaluation, the BLM recommends that the following actions would be taken to ensure the Standards are achieved:

- Develop an adaptive management framework to make progress towards achieving Land Health Standards.
- Implement shrub reduction treatments that target creosote and whitethorn acacia in Limy and Shallow Uplands.
- Construct erosion control features and implement roadway work best management practices to reduce impacts from old mining features.
- Construct the SPRNCA and allotment boundary fence lines.
- Use the existing water sources on private land to develop pipelines on existing roadways to troughs already within BLM lands to increase reliability of permanent water sources.
- Change allotment management category from M (Maintain) to I (Improve).
- Complete fencing along the west side of the San Pedro River (to exclude cattle from the river) and reconstruct a permanent water source on private land to the west of the San Pedro River.

7.1.1 Cultural Resources

Future cultural resources inventory and assessment should focus on BLM-administered areas where livestock may concentrate, such as along waterways and the location(s) of any existing or proposed range improvements. If, as a result of assessment or monitoring, historic properties are identified and found to exhibit potential for or actively occurring grazing impacts, mitigation measures would be developed in coordination with the State Historic Preservation Office and other interested or affected parties, including Native American tribes.

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