United States Department of the Interior
Bureau of Land Management

Rangeland Health Evaluation

Horseshoe Allotment (06235)

August, 2018

Agua Fria National Monument
Yavapai County, Arizona

U.S. Department of the Interior
Bureau of Land Management
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Table of Contents

Abstract

This Land Health Evaluation (LHE) is a stand-alone report designed to ascertain compliance with the Arizona Standards for Rangeland Health on the Horseshoe Allotment (Allotment). As part of this Land Health Evaluation, current upland and riparian monitoring data has been collected, analyzed, and evaluated by the BLM. The upland portions of the Allotment are meeting standards one in good to excellent ecological condition. The riparian portions of the Allotment are not meeting standard two due to environmental factors such as drought and continued sediment loading from the 2005 Cave Creek Complex Fire. Both upland and riparian areas on the Allotment are meeting standard three. Current livestock grazing management practices are considered to be in conformance with the set Standards and Guidelines.
Standard One is being achieved on the Allotment.
Standard Two is not being achieved on the Allotment.
Standard Three is being achieved on the Allotment.

1.0 Introduction

This LHE was conducted in accordance with the direction set forth in the Washington Office Instruction Memorandum No. 98-91 and Arizona No. 99-012 for implementation of Standards for Rangeland Health and Guidelines for Grazing Administration. The purpose of the standards and guidelines is to improve the health of the public rangelands. The standards and guidelines are intended to help the Bureau of Land Management (BLM), rangeland users, and others focus on a common understanding of acceptable resource conditions and work together to achieve that vision. The Decision Record for implementation of Arizona Standards for Rangeland Health and Guidelines for Grazing Administration Environmental Assessment was approved by the Arizona State Director in April 1997 (USDI, BLM, 1997). This decision became effective upon approval of the Arizona Standards and Guidelines by the Secretary of Interior in April 1997. The Decision Record allowed for full implementation of Arizona Standards for Rangeland Health and Guidelines for Grazing Administration in all Arizona BLM Land Use Plans.

Definition of Standards and Guidelines

Standards of rangeland health are expressions of levels of physical and biological condition or degree of function required to have healthy, sustainable rangelands. Standards define minimum resource conditions that must be achieved and maintained. Determination of rangeland health is based upon conformance with the standards. Application of the standard to the ecological site considers the potential of the site without regard for the types or levels of use or management actions or decisions.

Guidelines, on the other hand, do consider type and level of grazing use. They are tools that help managers and permittees achieve standards and are specific to livestock grazing. Guidelines are best management practices such as grazing systems which could be used to achieve rangeland health 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 by domestic livestock. Other contributing factors may include, but are not limited to, past land uses, land use restrictions, recreation, wildlife, rights-of-way, feral horses and burros, mining, fire, weather, and insects and disease (Arizona Standards for Rangeland Health and Guidelines for Grazing Administration, 1997).

With the commitment of BLM to ecosystem and interdisciplinary resource management, the standards for rangeland health as developed in this current process will be incorporated into management goals and objectives. The standards and guidelines for rangeland health for grazing administration, however, are not the only considerations in resolving resource issues (Arizona Standards for Rangeland Health and Guidelines for Grazing Administration, 1997).

2.0 General Description of the Allotment

The Horseshoe Allotment is bisected by the Agua Fria River in SE Yavapai County, Arizona. It is about 15 miles north of Black Canyon City, two miles south of Cordes, AZ, between I-17 and the Tonto National Forest boundary to the east. Elevations range from 3300 feet to over 4600 feet and annual precipitation is about 14 inches on average. The land area is classified by the Natural Resources Conservation Service (NRCS) as part of the Mogollon Transition Area in central Arizona. This region separates the Basin and Range in southern Arizona from the Colorado Plateau in the northern part of the state. The Major Land Resource Area (MLRA) is 38-1. Geology dominates the landscape. To the west are hills of some of the oldest rocks in Arizona. Proterozoic (precambrian) granitic rocks over 1 billion years old are found exposed on the west side of the Agua Fria River. They are covered on the east side of the river by much younger volcanic rocks of the mid to late Miocene. Several basalt flows occurring 10-20 million years ago originated from vents like Joe's Hill, an extinct shield volcano on the Allotment (Leighty, 1997). In general, shallow gravelly soils have formed on the highly weathered and erosive granitic rocks producing shrubby vegetation. In contrast, deep clayey soils have formed on the resistant and younger basalt mesas producing lush semi-desert grasslands (McAuliffe and King, 2010).

Riparian areas are located within major drainages of the Horseshoe Allotment. This includes the Agua Fria River, Silver Creek, Indian Creek, and Bishop Creek. There are approximately 16 miles of riparian habitat are located within the Allotment. Cottonwood and Gooding's willow dominate the canopy cover. Groundcover is provided by an assortment of sedges, rushes and grasses. Many portions of the Agua Fria River and tributaries are intermittent and do not support vigorous riparian vegetation. Frequent high flow events during winter storms and monsoons often scour out vegetation in portions of the active channel.

3.0 Livestock Grazing

3.1 Grazing History

The Horseshoe Ranch was established in 1882 by William Mitchell, a wealthy mining magnate from Philadelphia. A patent was issued for 160 acres of private land on 12-16-1889. Information from 1880 to 1960 is from AZ State Land Department (ASLD) records is scarce. From 1960 through 1982 the Horseshoe Ranch, consisting of the Horseshoe Allotment of the ASLD (#05-2074) and the Copper Creek Allotment of the United States Forest Service (USFS), was owned and operated by Louis and Billie Wingfield. They ran between 700 and 800 cows yearlong on the ranch. From 1982 through 1990 the authorized grazing use on 25,450 acres of state lands on the Horseshoe Allotment was 341 animal units (AU). In 1986 the leases were assigned to Horseshoe Ranch Inc. In 1990 the authorized grazing use on state lands was reduced to 329AUs. In 1998 Arizona State land on the Horseshoe Allotment transferred to the BLM through a land exchange. The Allotment became part of BLM's Agua Fria National Monument on 1-11-2000 via Presidential Proclamation #7236 under the Antiquities Act of 1906. Grazing ceased on the Horseshoe Allotment in 2006. Grazing ceased on the USFS Copper Creek Allotment in 2002 due to severe drought. In 2011 the AZ Game and Fish Department (AGFD) purchased the 199 acre headquarters of the Horseshoe Ranch along the Agua Fria River. In 2012 the Allotments were leased to JH Cattle Company (John Holbrook) from the AGFD and grazing resumed on the BLM Horseshoe Allotment and Tonto National Forest Copper Creek Allotment.

3.2 Current Livestock Grazing Management

Livestock are currently authorized to graze year-round within the Horseshoe Allotment. The lessee is authorized to graze 381 cattle, which equals 4572 Animal Unit Months (AUMs). The lessee has not used the full authorized amount of AUMs since obtaining the lease in 2011. Refer to Table 1 for more information about current grazing within the Allotment.

Table 1. Mandatory Terms and Conditions for Permitted Use

Allotment Name	Allotment Number	Livestock Number	Kind	Grazing Begin	Period End	% Public Land	Type Use	Animal Unit Months (AUMs)
Horseshoe	06235	381	Cattle	3/01	2/28	100	Active	4572

3.3 Actual use

Actual Use reporting is not required for the Horseshoe Allotment. Actual use reporting is an optional term and condition that had been included on prior grazing authorizations. Livestock numbers provided in the tables below are based on ranch records provided by the authorized user or billed use.

Table 2. Horseshoe Allotment

Number of Active Livestock	Kind	Grazing Begin	Period End	% Public Land	AUMs
232	Cattle	01/01/2014	2/28/2014	100	450
232	Cattle	03/01/2014	07/08/2014	100	992

4.0 Allotment Profile

The Horseshoe Allotment consists of 29,851 acres of BLM administered lands. The Horseshoe Ranch also includes an adjacent USFS Allotment on the Cave Creek District of the Tonto National Forest. The Copper Creek Allotment is about 35,899 acres. JH Cattle Co. holds both leases. This document focuses on the BLM Horseshoe Allotment.

4.1 Soils and Ecological Sites

Soils on the Allotment were mapped as part of the Soil Survey of Yavapai County, Western Part (AZ #637), by the Natural Resource Conservation Service (NRCS), then Soil Conservation Service (SCS), soil scientists during the 1960s and 70s. The survey was published in March 1976 as part of the National Cooperative Soil Survey (USDA, NRCS, 1976). Since the publication of this survey, soil taxonomy has evolved and current information on boundaries of both soil moisture and soil temperature regimes require an update of the information provided in the 1976 soil survey for AZ #637. Soil map unit lines may not change but soil names, soil temperature and moisture regime boundaries will change. Soils on the Allotments were mapped within six major soil mapping units (map symbols are noted, ie: BmF).

Vegetation is described by ecological site for major soil mapping units on the Allotment. Four ecological sites dominate the majority of the landscape of the Horseshoe Allotment. All are within MLRA 38-1, the 12-16 inch precipitation zone of the Mogollon Transition Area in central Arizona.

Soil and vegetation descriptions

BmF – Barkerville cobbly sandyloam, 20-60% slope. This mapping unit consists of shallow soils mapped on hillslopes of granitic parent materials. Barkerville soil series is classified as Sandy-skeletal, mixed, mesic Aridic Ustorthents (SSSA, 2008). The soil moisture regime described by the 1976 survey is correct but the soil temperature regime is not. The entire Horseshoe Allotment is actually within the Thermic soil temperature regime. During field

investigations two soils were described at BLM Assessment, Inventory and Monitoring strategy (AIM) plots within this soil mapping unit. The first soil described at AIM plot GH2B (South River Pasture) would fit Lampshire soil series, a Loamy-skeletal, mixed, superactive, nonacid, thermic Lithic Ustic Torriorthents. This shallow soil occurred on a 25% south facing slope. It consisted of a gravelly sandyloam A horizon from 0-5 inches, a C horizon (extremely gravelly loamy sand) from 5-20 inches and weathered granodiorite bedrock at 20 inches. At AIM plot GH2 in the North River pasture a similar soil was described that would fit Oracle soil series, a Loamy, mixed, superactive, thermic, shallow Ustic Haplargids. This soil had a thin gravelly sandyloam A horizon from 0-2 inches, a Bt horizon (gravelly sandyloam) from 2-5 inches and an extremely gravelly sandyloam C horizon from 4-12 inches. Weathered granodiorite bedrock occurred at 12 inches. This soil showed signs of soil development due to clay elluviation probably because it occurred on a 5-15% northeast facing slope. Both soils act to produce a characteristic plant community dominated by shrubs, grasses, forbs and succulents. The ecological site present is called Granitic Hills 12-16 in.

Granitic Hills (R038XA104AZ)

This ecological site is on hillslopes at elevations from 3,300 to 4,600 feet on the Allotment. Slopes range from 20-60%. It forms nearly all of the land area within the North and South River pastures. Soil parent material consists of 1 plus billion year old granitic rock which is highly weathered and naturally erosive. Soils are shallow, gravelly and coarse textured. They lack water holding capacity for shallow rooted plants like grasses and forbs but weathered bedrock offers good opportunities for deeper rooted species to persist in the plant community.

The Ecological Site Description (ESD) published by NRCS describes a plant community which is a mixture of warm season perennial grasses like black (*Bouteloua eriopoda*), hairy (*Bouteloua Hirsuta*) and sideoats gramas (*Bouteloua curtipendula*), purple threeawn (*Aristida purpurea var. purpurea*), cane beardgrass (*Bothriocholoa barbinodis*), bush muhly (*Muhlenbergia porteri*) and tanglehead (*Heteropogon contortus)* and perennial forbs include shrubby deer vetch (*Lotus rigidus*), desert globemallow (*Sphaeralcea ambigua*), shrubby ayenia (*Ayenia microphylla*), desert marigold (*Baileya multiradiata*) and wishbone four o'clock (*Mirabilis bigelovii*). Sub-shrubs like false mesquite (*Calliandra eriophylla*), range ratany (*Krameria erecta*), rough menodora (*Menodora scabra*) and shrubby buckwheat (*Eriogonum wrightii*) are all good forage species and sub dominant to perennial grasses in the plant community. Snake weed (*Gutierrezia sarothrae*) is a common native sub-shrub that can increase due to heavy grazing and/or climatic conditions. It is short lived and will come and go over 15 to 20 years intervals. Large shrubs and succulents are important components of the plant community. On northern aspects shrubs like turbinella oak (*Quercus turbinella*), desert buckbrush (*Ceanothus greggii*) and redberry juniper (*Juniperus coahuilensis*) dominate this functional group. On southern aspects large shrubs and succulents like catclaw acacia (*Acacia greggii*), wait-a-bit mimosa (*Mimosa aculeaticarpa var. biuncifera*), Englemann and brownspine prickly pear (*Opuntia spp.*), hedgehog cactus (*Echinocereus spp*.), banana yucca (*Yucca bacata*) and gold flowered agave (*Agave chrysantha*) dominate this functional group. Annual grasses and forbs are common but occur in low amounts in the plant community.


Photo 1. BmF soil mapping unit, Granitic Hills in South River Pasture.

CaD – Cabezon – Springerville complex, 5-25% slopes. Springerville part
SnD – Springerville – Cabezon complex, 3-30% slopes. Springerville part
Rn – Rimrock – Graham complex, 3-15% slopes. Rimrock part

The Springerville and Rimrock portion of these three mapping units consists of moderately deep to deep clayey soils (40-60 inches) formed on basalt and related parent materials. Springerville soil series is classified as a deep, Fine, smectitic, mesic Aridic Haplusterts . The textures are clay and silty clay. The soil moisture regime is correct but the soil temperature regime is not. The entire Horseshoe Allotment is within the Thermic soil temperature regime. Rimrock soil is classified as moderately deep (20-40 inches), Fine, smectitic, thermic Leptic Haplotorrerts. The texture of Rimrock is cobbly clay. Both soils are vertisols with a predominance of 2:1 lattice clay minerals (smectite). The have high shrink-swell potential exhibiting deep cracking when dry and churning with an increase in volume over 20% when moist. We described a deep soil in the spillway below Boone Tank which was mapped as Springerville. Because the Horseshoe Allotment is not in the Mesic soil temperature regime we believe this soil better fits the concept of Bonita soil series. Bonita is classified as a deep, Fine, smectitic, thermic Typic Haplotorrerts. This soil had an A horizon from 0-2 inches light clay in texture, a Bt1 horizon from 2-10 inches with heavy clay texture and a Bt2 horizon from 10-48 inches with very heavy clay textures and hard basalt bedrock at 48 inches. It appears that the depth to bedrock is variable across the areas mapped as these soils and ranges from 40 inches to over 60 inches. During field investigations soil pits could not be dug deeper than 30 inches on any of the areas mapped as Springerville due to dry soils and dense clay horizons. In areas mapped as Rimrock, soils checked in the field fit well within that soil series. The ecological site is called Clayey Upland 12-16 in.

Clayey Upland (R038XA102AZ)

This ecological site is on plains and mesa tops at elevations from 3,350 to 4,000 feet on the Allotment. It occurs as most of the level (1-3% slopes) land area within the Bull, Boone Tank, Double Tanks and New Well pastures. It occurs in complex with Volcanic Uplands in most of the moderately sloping (2-6% slopes) areas of the Joe's Hill and Lousy pastures. These soils formed from pyroclastic materials (volcanic ash, glass and tuff) on 10-20 million year old basalt flows. The bedrock under these soils is hard and un-weathered. Soils are moderately deep to deep. The soils produce a characteristic grassland plant community dominated by plant species that can tolerate soil churning and cracking (vertic). These soils take water rapidly when dry as deep cracks capture surface water and transport it down

into the sub-soil. Soil surfaces are rough with a topography alternating between small basins and elevated areas trapping surface runoff on site. Cobbles are pushed to the surface as they weather from the basalt bedrock below. Clayey textures provide high water holding capacities for shallow rooted plants like perennial grasses, forbs and ephemerals. Base (cation) exchange capacities and organic matter are high, making these some of the most productive soils in the semi-desert grasslands.

The ESD describes a plant community dominated by tobosa grass (*Pleuraphis mutica*), a warm season perennial grass, which can tolerate vertic soil movement that most perennial grasses cannot. Other perennial grasses like bottlebrush squirreltail (*Elymus elymoides*) and vine mesquite (*Panicum obtusum*) can be common after a cycle of wet years but will naturally decline in drier periods. Native annual grasses and forbs of both the cool and warm season are very important in these plant communities and can produce large amounts of herbage in favorable seasons. Common warm season annuals include red sprangletop (*Leptochloa panicea var. brachiata*), six week grama (*Boutleoua barbata*) and annual threeawn (*Aristida adscenscionis*), purslane (*Portulaca spp.*) pigweed (*Amaranthus palmeri*), annual goldeneye (*Heliomeris longifolia var annua*) and morning glory (*Ipomoea costellata*). Important annuals of the cool season include little barley (*Hordeum pusillum*), Bigelow bluegrass (*Poa bigelovii*), sixweeks fescue (*Vulpia octoflora*), Indian wheat (*Plantago patagonica*), spreading fleabane (*Erigeron divergens*), tansy mustard (*Descurania pinnata*), annual mountain dandelion (*Agoseris heterophylla*) and tansyaster (*Machaeranthera spp*). Perennial forbs are minor components of the plant community but important species are blue dicks (*Dichelostemma capitatum*), bundleflower (*Desmanthis cooleyi*), wild onion (*Allium spp*.) and globe mallow (*Sphaeralcea coccinia*). Occasional subshrubs like shrubby buckwheat occur. The important succulent species include Engelmann prickly pear, brownspine and dollarjoint prickly pear (*Opuntia phaecantha and O. chlorotica*) and Whipple cholla (*Cylindropuntia whippeli*).

Photo 2. SnD soil mapping unit, Clayey Upland south of Boone Tank.

CaD – Cabezon – Springerville complex, 5-25% slopes. Cabezon part <15% slope
SnD – Springerville – Cabezon complex, 3-30% slopes. Cabezon part <15% slope
Rn – Rimrock – Graham complex, 3-15% slopes. Graham part
GsE – Graham soils 8-45% slopes. Graham part <15% slope

The Cabezon portion of the first two mapping units consists of shallow, clayey soils (< 20 inches) formed on basalt and related parent materials. Cabezon soil series is classified as a shallow Clayey, smectitic, mesic Aridic Lithic Argiustolls. The textures are clayey. The soil moisture regime is correct but the soil temperature regime is not. The

entire Horseshoe Allotment is within the Thermic soil temperature regime. Graham soil is classified as shallow, Clayey, smectitic, thermic Lithic Ustic Haplargids. The texture of Graham is cobbly clayloam to clay. Soil surfaces are well covered with gravels and cobbles. Cabezon should be switched to Graham to be correct taxonomically in the area. Soil investigations in the field showed many of these soils to be very shallow, cobbly clayloams to clays over hard basalt bedrock. Soil surfaces are well covered with gravels, cobbles and stones and rock outcrop makes up 1-5% of the area in these mapping units. At AIM plot VH 5 in the southern part of the Boone Tank pasture, a very shallow soil mapped as Cabezon would classify as a lithic ustic haplargid. This site had hard bedrock at 4 inches and was dominated by the colony forming, Toumey agave. On the north side of Joe's Hill a soil investigation at AIM plot CU 4B found a shallow to moderately deep, very cobbly, clayey soil similar to a series mapped on the San Carlos Apache Indian Reservation called Eskiminzen. This soil is similar to Graham but has cobbles and gravels throughout the soil profile. At AIM plot BH 1 on the northeast side of Joes Hill, soil investigations found a shallow clayey soil in complex with a deep soil like Bonita or Rimrock. The shallow component was 18 inches deep to hard basalt bedrock and fit the soil series concept of Graham very well. All of these soils mapped on slope less than 15% fit the ecological site called Volcanic Upland 12-16" pz.

Volcanic Upland (R038XA115AZ)

This ecological site occurs on toe-slopes and ridge tops at elevations from 3,350 to 4,000 feet on the Allotment. It occurs as most of the moderately sloping (3-15% slopes) land area within the Bull, Boone Tank, Double Tanks and New Well pastures. It occurs in complex with Clayey Uplands in most of the moderately sloping (3-15% slopes) areas of the Joe's Hill and Lousy pastures, where it can be recognized in part by its broader mix of perennial plants. These soils formed from volcanic parent materials on 10-20 million year old basalt flows. The bedrock under these soils is hard and un-weathered. Soils are shallow and very shallow. The soils produce a diverse plant community dominated by a mixture of perennial grasses and forbs, with sub dominance of sub-shrubs, large shrubs and succulents. Annual species are important in the plant community. Shallow soils, rock outcrop and high gravel and cobble cover combine to reduce the frequency of natural occurring wildfire on this site. These soils are clayey but not deep enough to exhibit vertic (cracking and churning) soil properties. They can be gravelly or cobbly throughout the soil profile. Water holding capacity is good near the soil surface for shallow rooted plants but soil depth limits total water holding capacity.

The ESD describes a plant community dominated by perennial grasses and forbs like sideoats grama, black grama, tobosa, bottlebrush squirrletail, slim tridens (*Tridens muticus*), sand dropseed (*Sporobolous cryptandrus*), cane beardgrass, curly mesquite (*Hilaria berlangeri*), purple threeawn, desert globe mallow, scarlett globemallow, blue dicks and wild onion.

Shrubs are important in the plant community and include low growing species like shrubby buckwheat, rough menodora and snakeweed and larger species like catclaw acacia and wait-a-bit mimosa. Succulents are common and include gold flower agave, Toumeyi agave (*Agave toumeyiana*) hedgehog cactus, prickly pear species, Whipple, buckhorn and pencil chollas (*Cylindropuntia acanthocarpa, and C. leptocaulis*) and banana yucca.

Photo 3. Rn soil mapping unit, Volcanic Upland at Copper Trap # 1, exclosure T-2.

CaD – Cabezon – Springerville complex, 5-25% slopes. Cabezon part > 15% slope
SnD – Springerville – Cabezon complex, 3-30% slopes. Cabezon part >15% slope
VtE – Venezia – Thunderbird complex, 15-40%. Venezia part >15% slope
GsE – Graham soils 8-45% slopes. Graham part > 15% slope

The Cabezon portion of the first two mapping units consists of shallow, clayey soils (< 20 inches) formed on basalt and related parent materials. Cabezon soil series is classified as a shallow Clayey, smectitic, mesic Aridic Lithic Argiustolls. The textures are clayey. The soil moisture regime is correct but the soil temperature regime is not. The entire Horseshoe Allotment is within the Thermic soil temperature regime. Venezia soil is classified as a Loamy, mixed, superactive, mesic Aridic Lithic Haplustolls. Again, the soil moisture regime is correct but the soil temperature regime is not. In filed investigations this soil concept exists but instead of being a mesic, haplustoll the classification should be a thermic ustorthent.

Graham soil is classified as shallow, Clayey, smectitic, thermic Lithic Ustic Haplargids. The texture of Graham is cobbly clayloam to clay. Soil surfaces are well covered with gravels and cobbles. Cabezon and Venezia should be switched to Graham to be correct taxonomically in the area.

Soil investigations at AIM plot CS 1 in the SE corner of the Double Tanks pasture showed two soils on a moderately steep hillslope. One was very shallow (7 inches to basalt) and clayey, similar to Graham series. The other was very shallow (6 inches) and loamy and would fit the concept of an ustorthent. This area was mapped as Venezia (incorrect soil temperature regime). At AIM plot BH 2B along the north boundary fence in the Boone Tank pasture, a shallow soil mapped as Venezia (north exposure) fit the series concept of Graham very well. All of these soils, mapped on slopes over 15%, fit the ecological site called Volcanic Hills, clayey 12-16” pz.

Volcanic Hills, Clayey (R038XA117AZ)

This ecological site is on hillslopes and ridges at elevations from 3,350 to 4,500 feet on the Allotment. It occurs in complex with Volcanic Uplands as most of the moderately sloping (15-30% slopes) land area within the Bull, Boone Tank, Double Tanks and New Well pastures. It occurs in complex with Volcanic Uplands in most of the steeply sloping (15-45% slopes) areas of the Joe’s Hill and Lousy pastures. These soils formed from volcanic parent materials

on dissected, 10-20 million year old basalt flows. The bedrock under these soils is hard and un-weathered. Soils are shallow and very shallow. They soils produce a diverse plant community dominated by a mixture of perennial grasses and forbs, with sub dominance of sub-shrubs, large shrubs and succulents. Trees can be common on cooler aspects. Annual species are important in the plant community. Shallow soils, rock outcrop and high gravel and cobble cover combine to reduce the frequency of natural occurring wildfire on this site. These soils are clayey but not deep enough to exhibit vertic (cracking and churning) soil properties. They can be gravelly or cobbly throughout the soil profile. Water holding capacity is good near the soil surface for shallow rooted plants but soil depth limits total water holding capacity.

The ESD describes a plant community dominated by perennial grasses and forbs like sideoats grama, black grama, hairy grama, Hall's panic (*Panicum hallii*), tobosa, slim tridens, sand dropseed, cane beardgrass, bottlebrush squirrletail, bull grass (*Muhlenbergia emersleyi*), curly mesquite, purple threeawn, desert globe mallow, scarlet globemallow, blue dicks, and wild onion.

Shrubs are important in the plant community and include low growing species like shrubby buckwheat, rough menodora and snakeweed and larger species like turbinella oak, skunkbush sumac (*Rhus trilobata*), catclaw acacia and wait-a-bit mimosa. Succulents are common and include gold flower agave, hedgehog cactus, prickly pear species, Whipple, buckhorn and pencil chollas (*Cylindropuntia acanthocarpa, and C. leptocaulis*) and banana yucca. Trees of redberry juniper can be common on north aspects and netleaf hackberry (*Celtis laevigata var reticulata*) and velvet mesquite can occur on warm exposures.

Photo 4. VtE soil mapping unit, Volcanic Hills, clayey at AIM CS-1.

Four minor soil mapping units occur on the Horseshoe Allotment. Two of these were labelled as rockland, a non-soil unit. The other two are upland areas of loamy soils which make up less than 1% of the Allotment, but one primary and two secondary AIM plot locations were selected on one of these units.

Ro, Rr – Rockland

These two mapping units lumped all of the steep slopes of canyons that cut the basalt mesas into a miscellaneous mapping unit called Rockland. This includes the canyon slopes of the lower Agua Fria, Silver Creek, Baby Canyon, Perry Tank Canyon and Lousy Canyon. These steep walled canyons contain a high percentage of rock outcrop but in many places soils do exist and plant communities are diverse and productive. By ocular assessment some of these slopes would fit well into the ecological site concept of Volcanic Hills, clayey 12-16" pz. In other areas, primarily along the Agua Fria Canyon where old lakebed sediments are still present, soils would probably be classified to

family such as torriorthents / calciorthids. An ecological site developed on the San Carlos Apache Indian Reservation in a similar setting is called Basalt Hills / Sandstone Hills 12-16" pz. (R038XA118AZ).

Photo 5. Rr - Rockland mappint unit, Silver Creek north of Pueblo la Plata.

LkD – Lonti Gravelly loam, 15-30% slopes

The small area of Lonti soils occurs near the Horseshoe Ranch headquarters. Three AIM plot locations (LU-4, LU-2B and LU-5B) are located on these small areas. Lonti is classified as a Fine, mixed, superactive, mesic Ustic Haplargids. The classification is correct except the soil should be in the Thermic soil moisture regime and not Mesic. A comparable soil series which may fit this area is called Eloma. It is classified as a Clayey-skeletal, mixed, superactive, thermic Ustic Haplargids. The ecological site description for this unit is called Clayey Slopes 12-16" pz. This area was not visited during field investigations in 2014 to confirm soil series concepts.

Clayey Slopes – R038XA108AZ

This ecological site occurs on hillslopes and ridges at elevations from 3,300 to 3,500 feet on the Allotment. Soils are fine family (Clayey) and very gravelly. They are formed in old stream alluvium deposits along the Agua Fria River and Silver Creek. This site is dominated by perennial grasses like tobosa, curly mesquite, sideoats grama and threeawn. Subdominant are sub-shrubs including false mesquite, shrubby buckwheat, range ratany and rough menodora. Succulents including prickly pear species, agave, hedgehog cactus and banana yucca are common. Large shrubs occur in lesser amounts and include catclaw acacia, wolfberry (*Lycium* spp.) and wait-a-bit mimosa. Annual forbs and grasses are plentiful in their respective seasons.

BdC – Balon Sandyloam, 0-15% slopes

Two very small areas of Balon soil occur in the eastern end of the Double Tanks pasture along the USFS boundary. There are no AIM plot locations on this soil mapping unit. Balon is classified as a Fine-loamy, mixed, superactive, mesic Ustic Haplargids. The classification is correct except the soil should be in the Thermic soil moisture regime and not Mesic. A soil series which may fit this area is called Courtland. It is classified as a Fine-loamy, mixed, superactive, thermic Ustic Haplargids. The ecological site would be called Sandyloam Upland 12-16" pz.

Sandyloam upland – ESD has not been published in MLRA38-1.

Photo 6. Summer monsoon near Perry Windmill.

4.2 Climate

Temperature: Temperatures on the Horseshoe Allotment are temperate; characterized by hot, dry summers and mild winters. The National Weather Service Station (WRCC # 022109) at Cordes, AZ is located at an elevation of 3,770 feet two miles northwest of the Allotment. It has a temperature record of 86 years from 1933 through 2017. Temperatures at the Cordes, AZ weather station indicate an increase of 1.3 degrees Fahrenheit (F) during the length of the record (Figure 1).

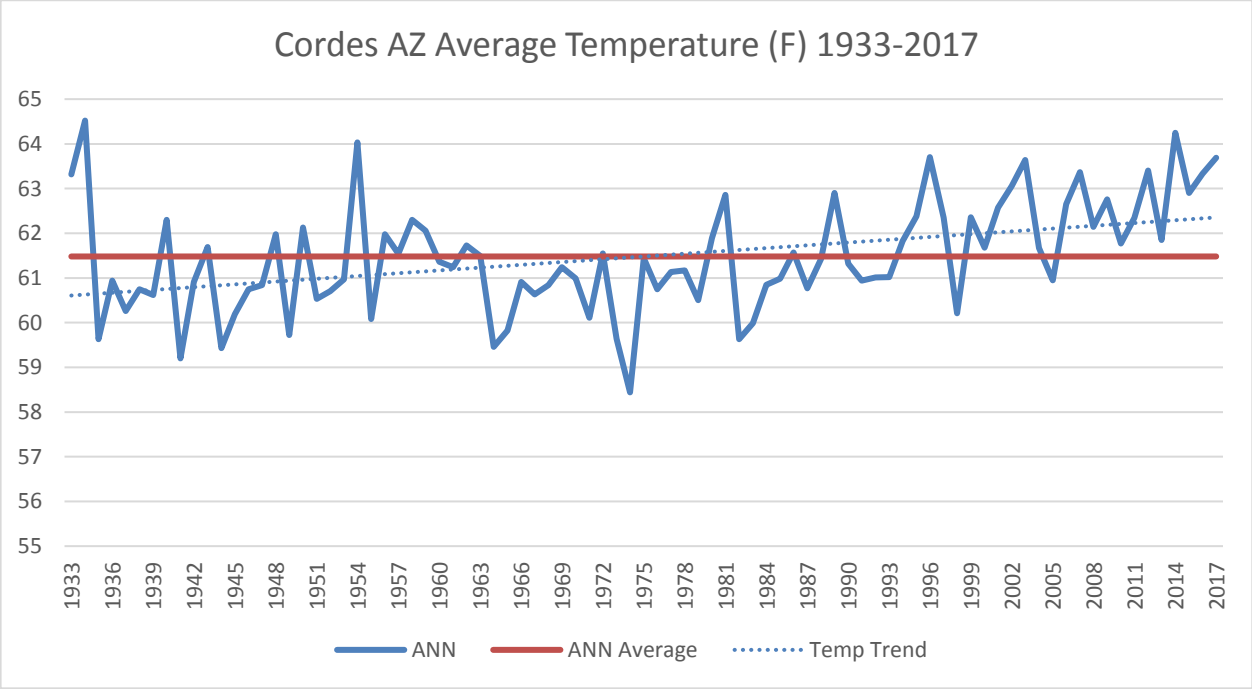

Figure 1. Average Annual Temperature (F) with Trend form Western Regional Climate Center Gauge (# 022109) in Cordes, AZ.

Figure 1 shows the increase in mean annual temperatures during the last 85 years. Mean annual temperatures have increased 1.3 degrees Fahrenheit (F) during the length of the record at Cordes, AZ.

Precipitation: Precipitation on the Horseshoe Allotment is bimodal in pattern with approximately 55% of the annual amount coming in the cool season (Oct.-Mar.) and 45% coming in the warm season (Apr.-Sept.). The Cordes, AZ NOAA station has a precipitation record spanning 88 years from 1926 through 2017. Precipitation at the weather station indicates periods of severe drought which is 70% mean precipitation (Figure 2) (SRM 2008). Since 1996, four years out of seventeen have been below 70% of mean annual precipitation or in severe drought. Compare that to the 1950s drought where four out of eight years were severe drought. *Note: Where data was missing five or more days individual months and/or individual years where not used to calculate annual or monthly statistics.

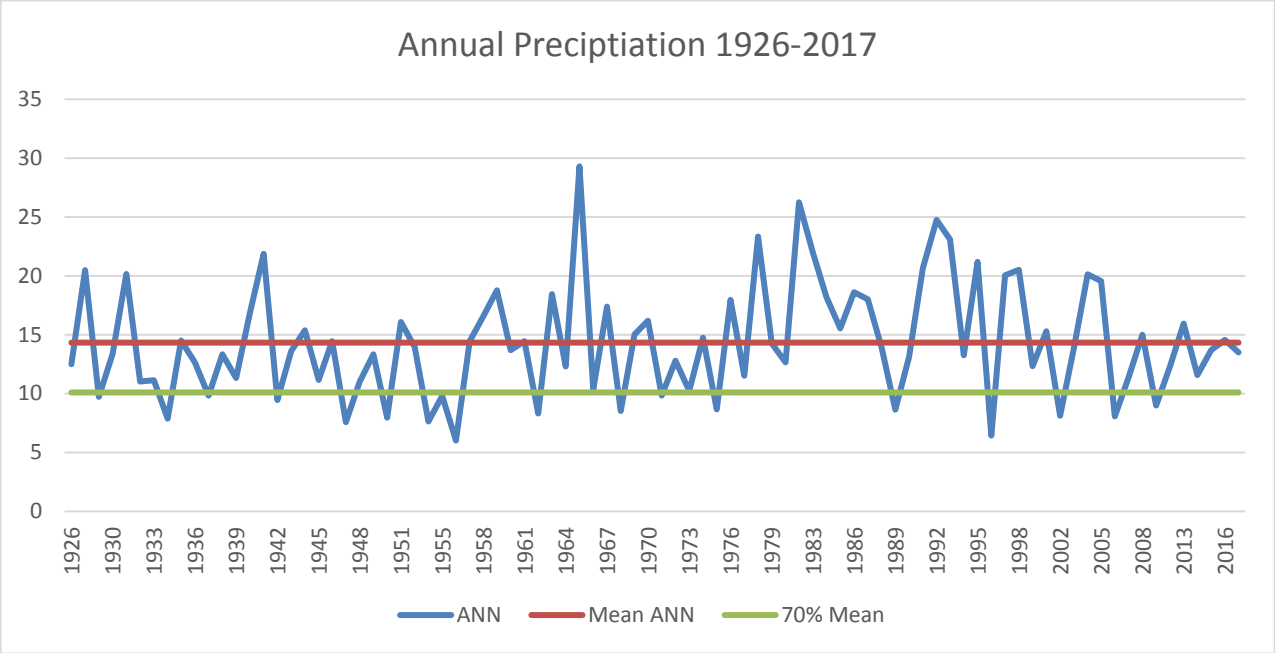

Figure 2. Average Annual Precipitation (in) from 1926-2017 form Western Regional Climate Center Guage (# 022109) in Cordes, AZ.

Figure 2 shows annual precipitation, mean annual precipitation (14.3 inches) and drought year (70% of mean annual, SRM 2008) precipitation for the 91 years recorded at Cordes, AZ.

One difference between the drought of the 1950s and that of the 2000s is the mean temperatures were below average in the 1950s and above average in the 2000s. Figures 3 and 4 compare temperature and precipitation from 1941-56 to 1996-2017 during the cool season (Oct.-Mar.). Temperatures have increased 2 degrees F during this period. The shift to milder winter temperatures causes the growing season to begin earlier in the spring. Plants green up and run out of soil moisture earlier in the spring. The spring summer drought period formerly was May and June, now it is April, May and June. This coupled with higher summer temperatures has resulted in significant perennial grass mortality especially in dry winters like the winter of 2010-11(McAuliffe and King, 2010).

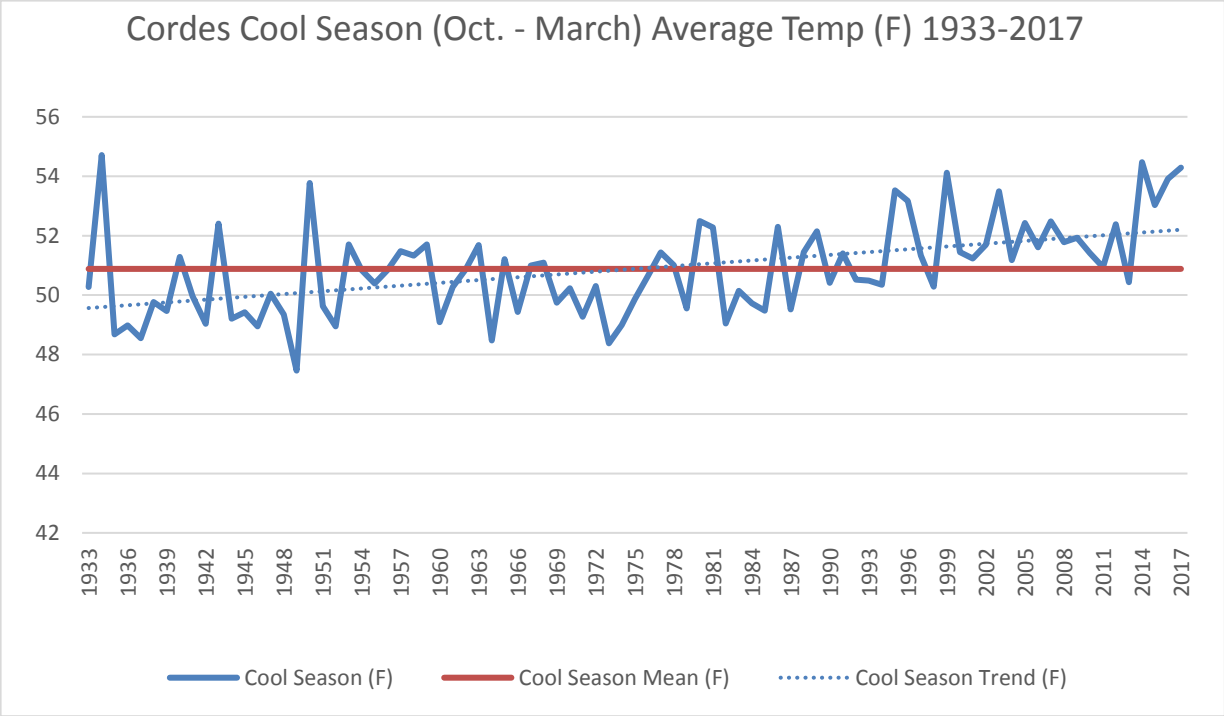

Figure 3. Cool Season (Oct - Mar) Average Annual Temperature (F) with trend 1933-2017 from the Western Regional Climate Center Guage # 022109.

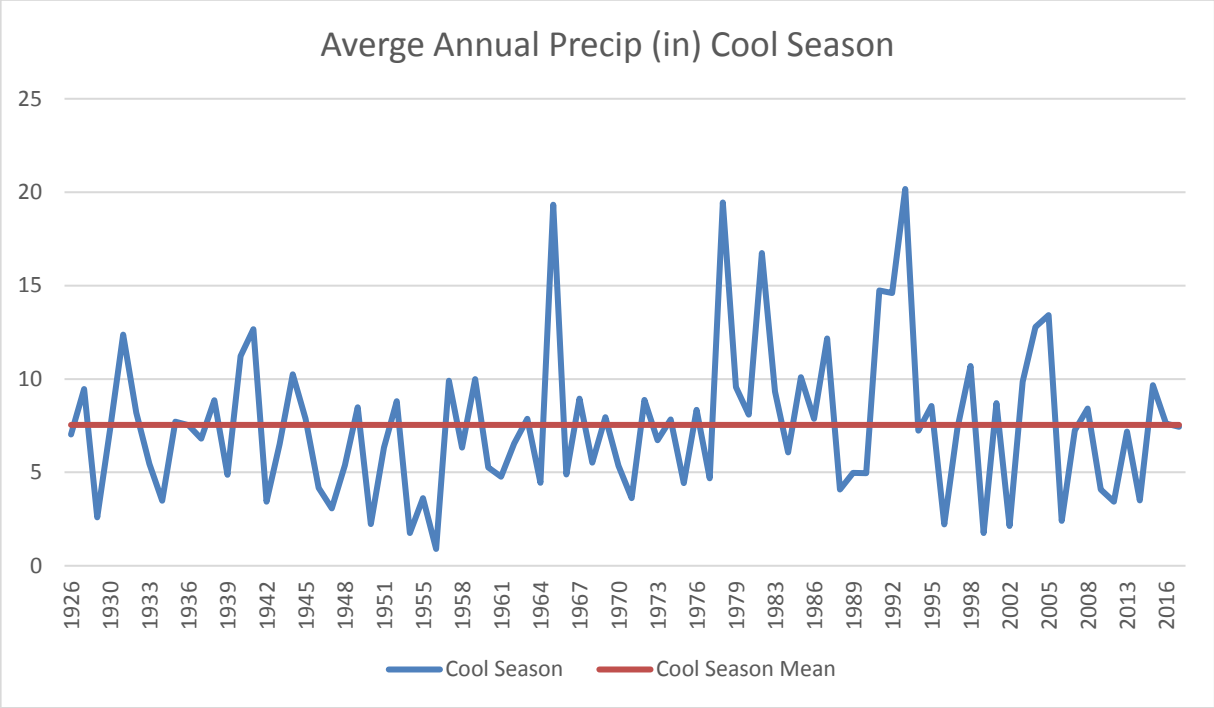

Figure 4. Cool Season (Oct-Mar) Average Annual Precipitation (in) 1926-2017 from the Western Regional Climate Center Guage # 022109.

Figures 5 and 4 show the increase in cool season (Oct-March) average annual temperature and the decrease in average annual precipitation since the late 1980's, respectively. Figures 3 and 4 illustrate how much cooler it was in the summer during the 50s drought than now. Also note the loss of summer rainfall from the year 2000 on. This combination of higher summer temperatures (greater evaporation and transpiration) and less summer rainfall during the past 14 years has resulted in less cover and production of perennial warm season plants like tobosa grass (*Pleuraphis mutica*). In addition the variance (coefficient of variation) in cool season precipitation has increased from 53% to 56% during the past 17 years at Cordes, AZ. The variance in warm season precipitation has increased from

40% to 44% at this location. An increase in variability in seasonal precipitation can place further stress on plants and animals trying to cope with increasing temperatures and drought.

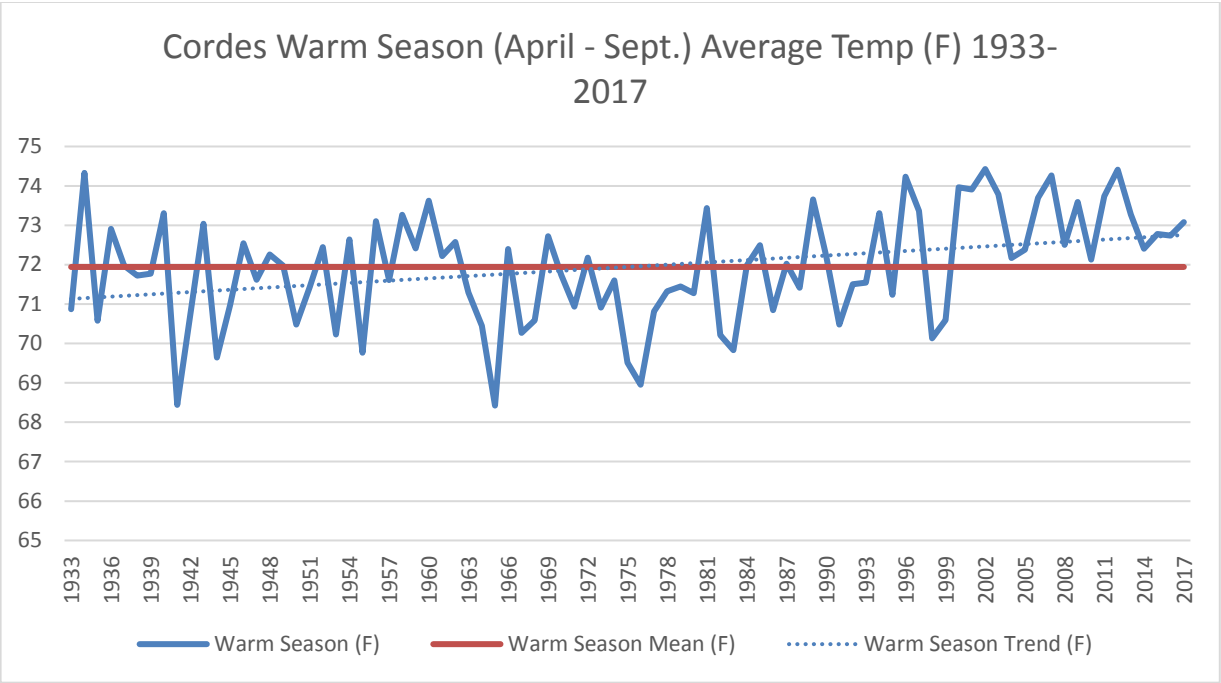

Figure 5. Warm season (Apr - Sept) average annual temperature (F) with trend 1933-2017from the Western Regional Climate Center guage # 022109.

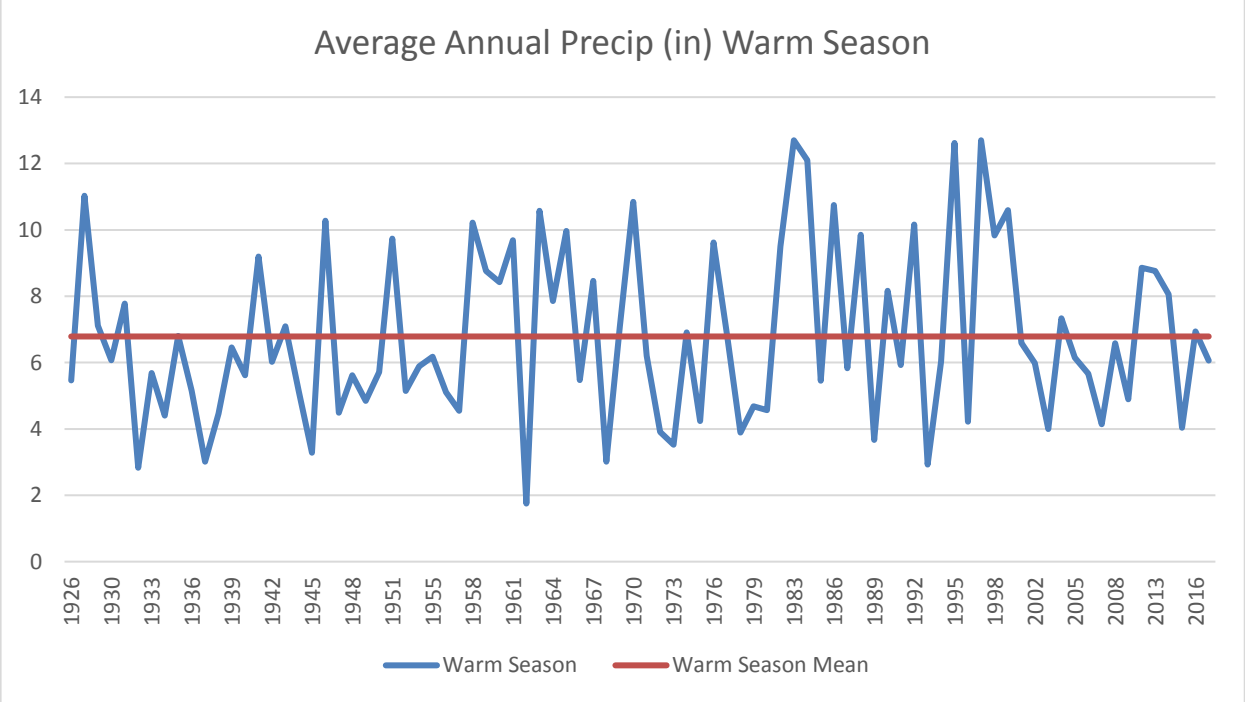

Figure 6. Warm season (Apr - Sept) average annual precipitation (in) 1926-2017 from the Western Regional Climate Center guage # 022109.

4.3 Fire History

Periodic fire is an integral component to maintaining tobosa grasslands (NRCS, 2018) including on the Horseshoe Allotment. Natural fire return interval is approximately 15 years typically occurring in June through August. An absence of fire for extended periods is known to allow for an increase in shrubs and cacti. A more frequent fire return

interval may cause a reduction in tobosa cover and allow annual grasses to dominate. Interactions between fire, drought and grazing can hinder recovery.

Prescribed fires were implemented in the mid-1990s and continued between 2009 and 2012 to maintain tobosa grasslands and improve pronghorn habitat (Map 6). In July 2017, the Brooklyn Fire burned approximately 15,000 acres on the Horseshoe Allotment and an additional 17,000 acres on the Copper Creek Allotment.

5.0 Wildlife Resources/Special Status Species

The Horseshoe Allotment is home to an abundance of wildlife. The large numbers of wildlife and rich diversity of species is attributed to the variety of vegetative communities. Vast desert grasslands are intersected by ribbons of riparian forests. This juxtaposition of ecosystems creates unique habitat characteristics rare in many portions of Arizona and supports a diverse assemblage of species. Use of the U.S. Fish and Wildlife Services IPaC tool (02EAAZ00-2018-E-02055) found multiple listed species may occur within the Horseshoe Allotment and both critical habitat and proposed critical habitat is located within the Allotment (Table 3) (IPaC site accessed June 13, 2018). The Arizona Environmental Online Review tool was cross referenced to identify listed and BLM sensitive wildlife and plant species as well as Arizona State Species of Special Concern that may occur within the Horseshoe Allotment (HGIS 02493) (azhgis2.esri.com site accessed July 24, 2018). Species lists derived from the tool include historic records and a five mile buffer around both the Horseshoe and Copper-Creek Allotments (Appendix 1). Consequently, many species identified in the review tool do not currently occur within the Horseshoe Allotment.

Desired plant community objectives discussed in section of 8 of this document are based on focal wildlife species, all of which are Arizona State Species of Special Concern (identified in Appendix 1 as SGCN) and several are listed under the Endangered Species Act (ESA). These species include the yellow-billed cuckoo (*Coccyzus americanus*), Gila chub (*Gila intermedia*), and pronghorn antelope (*Antilocapra americana*). Desired Plant Community objectives for ESA listed species and Arizona State Species of Special Concern in both riparian and upland areas of the Allotment are evaluated under Standard three of the Arizona Standards for Rangeland Health and Guidelines for Grazing Administration leading to a determination of standard achievement or significant progress toward standard achievement.

Table 3. IPaC list (updated on June 13, 2018) of Endangered Species Act listed species, critical habitat designation, and current conditions of listed species known to occur in or in close proximity to the Horseshoe Allotment.

Birds	Status	Critical Habitat	Habitat and Allotment Specific Information
Yellow-Billed Cuckoo (*Coccyzus americanus*) Population Western U.S. DPS	Threatened	Proposed	Riparian obligate. Known to occur seasonally within the Agua Fria River, Indian Creek and Silver Creek.
Fishes			
Desert pupfish (*Cyprinodon macularius*) Population: Wherever found	Endangered	Final	Riparian obligate. Species may be present within Lousy Canyon. No critical habitat within Allotment.
Gila chub (*Gila intermedia*) Population: Wherever found	Endangered	Final	Riparian obligate. Known to occur in Silver Creek and Lousy Canyon. Critical habitat designated within the Allotment.
Gila topminnow (*Poeciliopsis occidentalis*) Population: Wherever found	Endangered	NA	Riparian obligate. Known to occur in Lousy Canyon. No critical habitat within Allotment.
Reptiles			
Northern Mexican gartersnake (*Thamnophis eques megalops*) Population: Wherever found	Threatened	Proposed	Riparian obligate. Species may be present within Allotment and currently on AGFD Horseshoe Range. Proposed critical habitat within Allotment.

The threatened yellow-billed cuckoo, a riparian dependent migratory bird species, has documented breeding areas within the Horseshoe Allotment. The Agua Fria River has the greatest concentration of breeding activities as illustrated from multiple years of survey. Critical habitat has been proposed in the Agua Fria River and Indian Creek as of August 2014 (FWS-R8-ES-2013-011; 4500030114). Primary constituent elements for the species are listed in the Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-Billed Cuckoo (USFWS 2014).

Refuge populations of the endangered Gila Chub occupy Silver Creek and Lousy Canyon which were designated as critical habitat in 2005 by the United States Fish and Wildlife Service (USFWS) (USFWS, 2005). However, in Silver Creek, the species is now restricted to below areas designated as critical habitat due to heavy sediment loads from the 2005 Cave Creek Complex fire. Gila chub were stocked from Silver Creek into in Lousy and Larry Canyons to preserve the lineages prior to the great reduction in habitat quality and quantity in Silver Creek. Primary constituent elements for the species can be found in the Endangered and Threatened Wildlife and Plants; Listing the Gila Chub as Endangered With Critical Habitat (USFWS 2005).

Two other endangered fish species have or do occur within Lousy Canyon of the Horseshoe Allotment. The endangered Gila topminnow (*Poeciliopsis occidentalis*) is currently found within Lousy Canyon of the Horseshoe

Allotment. Gila topminnow are abundant within Lousy Canyon. The desert pupfish was stocked in Lousy Canyon in the early 2000s but has not been documented since following six years of survey efforts.

The northern Mexican gartersnake, a riparian dependent snake, has been documented within the Agua Fria River as recently as the 1980s. However, a pond at Horseshoe Ranch was stocked with the species in 2017. Critical habitat has been proposed within the main stem of the Agua Fria River as of July 2013 (FWS-R2_ES-2013-0022; 4500030113). The FWS proposed rule states that the Mexican gartersnake proposed critical habitat is considered as being within the geographical area currently occupied by the species. The areas are proposed under sections 3(5)(A)(i) of the Act because they are essential for conservation of the northern Mexican gartersnake.

BLM sensitive species occur though riparian areas of the Horseshoe Allotment including longfin dace (*Agosia chrysogaster*), desert sucker (*Catostomus clarkii*), lowland leopard frog (*Lithobates yavapaiensis*), and Sonoran mud turtle (*Kinosternon sonorensis*). Sonoran desert tortoise (*Gopherus morafkai*) may occur within canyons of the Agua Fria River canyon. This area which contains approximately 1500 acres of Category II desert tortoise habitat is generally inaccessible to livestock due to steep slopes.

Many non-native fish species have been documented in the streams and creeks within the Horseshoe Allotment. Non-native games fish include the green sunfish (*Lepomis cyanellus*) and fathead minnow (*Pimephales promelas*). Additionally, non-native crayfish (*Orconectes virilis*) and bullfrogs (*Lithobates catesbeianus*) also occurs throughout riparian areas of the Allotment.

The Horseshoe Allotments is found within Game Management Unit (GMU) 21. Wildlife species found within the Allotment include large mammals such as pronghorn, mule deer, white-tailed deer, mountain lion, black bear, coyote, as well as various rodents, bats, and other small mammals. The pronghorn antelope is considered a focal species and desired plant community objectives were developed for the species. Approximately 11,336 acres of Horseshoe Allotment has been identified as fawning grounds for pronghorn antelope and approximately 20,200 acres are identified as movement corridors. To date 197 bird species have been recorded in the area. Portions of the Horseshoe Allotment are designated as an Important Bird Area by the Audubon Society.

6.0 Vegetation Resources

6.1 Noxious Weeds/ Invasive Weeds

Invasive annual forbs and grasses are common on clayey soils on the Horseshoe Allotment. They include filaree, red brome, wild oats, foxtail barley and tumble mustard. These are all cool season annual species and to some degree, have blended with the populations of native, winter, annual grasses and forbs. Two species on the Allotment, red brome and wild oats provide very high and continuous fine fuel loads in springs with above average precipitation. Wildfires, like those in 2005, fueled by these species and coupled with drought, have had serious consequences on native plant communities in the tobosa grasslands on Perry Mesa. On the southwest end of Perry Mesa black mustard (*Brassica nigra*) is beginning to spread. Maintenance of perennial plant species cover is an important factor in reducing the spread of weeds.

6.2 Vegetation Inventory and Monitoring

MLRAs
The broad climatic/geographic zones, MLRAs, correspond to geographic provinces or ecosystems. MLRA 35 is the Colorado Plateau, MLRA 40 is the Sonoran Desert, MLRA 38 the Mogollon transition area, and so on. A set of ecological site descriptions are developed for each precipitation zone in each MLRA. This information is gathered throughout the course of soil surveys by range specialists working with soil scientists (USDA, NRCS, 1997).

Ecological sites

An ecological site is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation (SRM 2008). Ecological sites are described with written narratives of the sites' physical characteristics, soils and natural vegetation. A potential native plant community is described for each ecological site including the percent composition of each species and plant functional group in the plant community. Information about potential native plant communities is developed from historic information and tempered with the best plant communities found for each ecological site. Best refers to the highest cover, annual production and diversity of life-forms encountered to date and is not related to land use. They are the recommended basic unit of rangeland classification (USDA, NRCS, 1997).

Composition
The proportion of an individual plant species as shown on NRCS ecological site descriptions is the composition by weight of annual production. Composition is determined by using several methods including Dry-Weight-Rank, double sampling, and ocular estimates. All of these methods are described in the Arizona range literature (Ruyle, 1997; Smith, et al. 2012; USDA, NRCS,1997).

Production
Annual production of the plant community is shown on NRCS ecological site descriptions with ranges from dry to wet years. Production is expressed as the above ground biomass of leaves, twigs, flowers and fruits produced in a year in lbs/ac. on an air dry basis. Production can be determined using several techniques including double sampling, comparative yield and ocular estimates. These methods are well described in the range literature (Ruyle, 1997 and Smith et al. 2012).

Ground Cover
Ground cover is the percentage of the ground surface that is covered by bases of perennial plants, gravel and rock and litter. It is measured using the Line-Point Intercept sampling in the AIM plot protocol (150 points recorded) or by using points welded on the frequency frame in the Pace Frequency format for monitoring (300 points).

Foliar Cover
Foliar cover is the percentage of the ground surface that is covered by the canopy of perennial plants. It is measured using the Line point sampling in the AIM plot protocol (150 points recorded).

Distribution of cover
Distribution or arrangement of plant cover on the site is the pattern of both basal and foliar cover. It can be a sensitive indicator to thresholds where soil erosion can accelerate or when perennial plant communities may not be able to recover. It is measured using canopy gap measurements in the AIM plot protocol (150 meters of line intercept for canopy gaps).

Vegetative Trend
Vegetative trend is the direction plant communities take over time. Trend can be measured in several ways. Both foliar cover and shrub density can be recorded over time in the AIM protocol using line point and belt sampling. These data can be compared to subsequent readings to determine trend towards meeting land health objectives. The AIM protocol is the new method being put in use by BLM in Arizona and elsewhere across the country. Frequency is another method which has been used on the Allotment. Frequency in a pace transect format can yield sensitive information about directions or trends in plant communities. The pace-frequency format developed at the University of Arizona is described in the Arizona range literature (Ruyle, 1997 and Smith et al. 2012).

The most important thing in any vegetation monitoring is to keep sampling techniques the same from year to year and to ensure measurements are confined to a single soil or ecological site. Two range trend monitoring locations on the Horseshoe Allotment were visited in 2014. Each consists of a small (1 acre) exclosure with 100 quadrat pace-frequency transects installed inside and outside. The exclosures were constructed and transects installed in fall of 1994. They were re-read in 1996 but not since. The first location is called T-2 and is located in Copper Trap #1 on Clayey Upland ecological site. The second location is in the NE corner of Joe's Hill pasture near Perry Mesa Tank. It

is called T-3 and is located on a complex of Clayey Upland / Volcanic Upland ecological sites. Table 4 and 5 show the result of re-reading transects at T-2 and T-3 after an 18 year interval. Change can be interpreted from this kind of data but not trend (minimum of three data points). There is no way to know what happened in the last 18 years. Monitoring must be done often enough to separate out casual factors and determine normal fluctuations in plant communities over time. The exclosures at these locations offer a means of separating climate impacts on the plant community from grazing impacts. The exclosures should be maintained, rain gauges installed and recorded seasonally and the AIM protocol used both inside and outside to continue monitoring. Point cover data will be valid across both methods, frequency will not be.

Table 4. Comparison of T-2 paired plots in Copper Trap # 1 using Dry-Weight-Rank Method (1994-2014).

Copper Trap #1, T-2 Outside Exclosure								Copper Trap #1, T-2 Inside Exclosure							
	% frequency				% composition				% frequency				% composition		
	1994	1996	2014		1994	1996	2014		1994	1996	2014		1994	1996	2014
Cover category								**Cover category**							
Bare ground	19	60	34					Bare ground	34	60	25				
Gravel		5	3					Gravel		16	4				
Rock	7	10	6					Rock	14	8	9				
Litter	56	14	52					Litter	41	11	51				
Live basal	18	11	4					Live basal	11	5	11				
Shrub/succulent								**Shrub/succulent**							
mesquite	1							mesquite	1						
shrub buckwheat								shrub buckwheat	4	6	1		1		0
snakeweed	13	2			7		0	snakeweed	15	4			5		0
prickly pear								prickly pear	1		1				
Perennial grass								**Perennial grass**							
tobosa	87	92	56		14		37	tobosa	85	93	84		50		56
vine mesquite		2						vine mesquite		0					
squirrletail	14				3		0	squirrletail	8				3		0
Perennial forb								**Perennial forb**							
bundleflower								bundleflower			3				
ragweed		3	5		0		1	ragweed							
vetch / lotus								vetch / lotus		5					
Annual grasses	100	30	90		41		7	**Annual grasses**	99	45	100		32		13
Annual forbs	41	85	100		4		21	**Annual forbs**	38	95	100		5		24
ann goldeneye	1	0	82		0		35	ann goldeneye	4	0	77		0		13

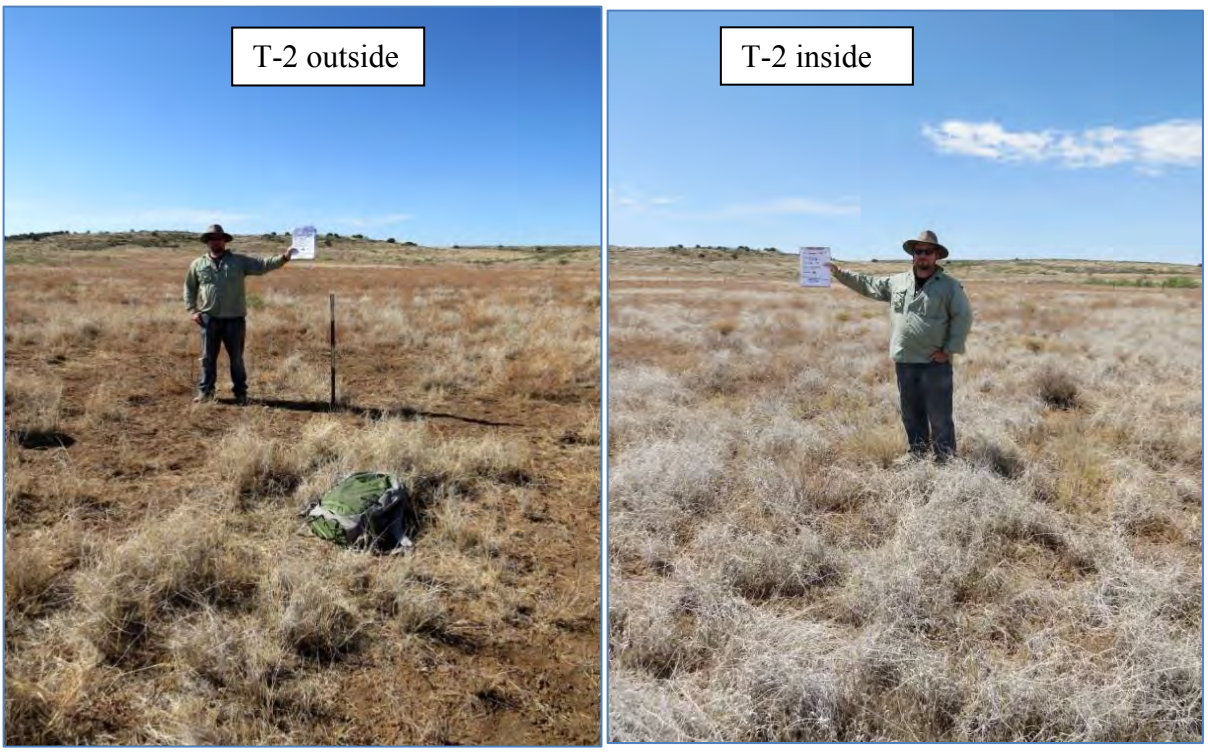

Photo 7. Comparison photos of paired plot exclosure T-2 in Copper Trap # 1.

Due to the time between readings it is difficult to look at the data from T-2 and draw conclusions. It appears that basal cover of tobosa has declined significantly outside the exclosure and increased back to some more normal amount inside. Inside the exclosure, basal cover went from 11% in 1994 to 4% in 1996, just two years. The decade prior to 1994 was the wettest on record in Arizona's climate history and by 1994 levels of basal cover were high. 1996 was a severe drought year and in both transects basal cover declined. Basal cover declined outside the exclosure from 18% to 11% and inside from 11% to 4%. These transects are only 200 feet apart. This could mean that there are dynamics in tobosa basal cover that are not well understood. There has been very little grazing in Copper Trap #1 for the past 9 years. Without monitoring data and land use records throughout this period it is impossible to draw conclusions from the results. An Upland Range Health assessment done on the area outside the exclosure in 2014 showed the area as meeting Standard 1 and with biotic integrity still intact.

Table 5. Comparison of Joe's Hills Exclosure (T-3) paired plots (1994-2014) using the Dry-Weight-Rank Method.

NE Joe's Hill, T-3 Outside Exclosure							
	% frequency				% composition		
	1994	1996	2014		1994	1996	2014
Cover category							
Bare ground	58	70	35				
Gravel	1	1	0				
Rock	12	8	9				
Litter	21	8	49				
Live basal	8	11	6				
Shrub/succulent							
shrub buckwheat	21	16	10		12		5
snakeweed	45	2	13		19		7
prickly pear	4	1	5		3		3
catclaw acacia	6	5	6		3		4
Perennial grass							
tobosa	56	65	57		30		37
threeawn	1	1	1				
curly mesquite			7				
vine mesquite	3				1		
squirrletail	3	6					
Perennial forb							
blue dicks	1						
ragweed		1	4				0.5
hairy goldaster			4				0.5
globemallow			1				1
Annual grasses	97	8	100		27		27
Annual forbs	47	44	100		5		7

NE Joe's Hill, T-3 Inside Exclosure							
	% frequency				% composition		
	1994	1996	2014		1994	1996	2014
Cover category							
Bare ground	54	70	26				
Gravel	3	0	2				
Rock	9	9	6				
Litter	23	6	62				
Live basal	10	15	4				
Shrub/succulent							
shrub buckwheat	6	11	10		3		4
snakeweed	42	1	6		20		3
prickly pear	2	1	8		2		4
catclaw acacia	2	7	4		1		1
Perennial grass							
tobosa	73	66	51		45		32
threeawn	1						
curly mesquite							
vine mesquite							
squirrletail	2		2				
Perennial forb							
blue dicks	1		2				
ragweed							
hairy goldaster			3				2
globemallow							
Annual grasses	96	30	100		25		38
Annual forbs	40	63	100		5		17

Photo 8. Comparison photos of paired plots outside (top) and inside (bottom) of Joe's Hill exclosure T-3.

The data in Table 5 show little difference inside and outside although the pictures look different. Note the loss in snakeweed after the wet decade ending in the early 1990s. Inside the exclosure it went from 42% to 1% frequency in two years, outside from 45% to 2%. It illustrates how the short-lived (10 years), increaser snakeweed reacts to climate and drought in the plant community. Basal cover of tobosa has declined in both transects but is not different inside and out. This location is only 0.1 miles from Perry Mesa tank, one of the few reliable ponds on the Allotment. It has received grazing pressure in the past couple of years. As with T-2 this location should be maintained as a monitoring location and upgraded to the AIM protocol.

Utilization

Utilization is the amount of the current year annual production of above ground biomass grazed by animals. It is expressed as percentage by weight (not volume). Utilization measurements are outlined in several Arizona rangeland references (USDA, NRCS, 1997; Smith et al. 2007; and USDI, BLM, 1996).

Utilization transects were completed in areas that had been grazed by livestock during the summer of 2014. The method used is called “Grazed-class”. 100 plants were sampled in a pace-transect format. Height-weight relationships

for forage species were developed from un-grazed plants in the field. The cow herd (150) was in the Double Tanks pasture during April to July of 2014. The herd was moved onto the Forest Allotment the end of July when utilization measurements were made. Utilization was judged on forage species within 0.25 miles of water at three locations, Copper Corrals, Bishop Well and Copper Tank in the Copper Trap #1. Table 6 shows the results of these measurements.

Table 6. Horseshoe Allotment Utilization.

Horseshoe Allotment, end of season grazing utilization			
	Grazing utilization expressed as percent by weight		
Key Forage Species	**Double Tanks, Bishop well**	**Double Tanks, AIM CS 1**	**Copper Trap 1, T-2 (outside exc)**
Tobosa	5	0	5
Sideoats grama	10	25	
Black grama	20	31	
Curly mesquite	18		
Red threeawn	21	29	
Sand dropseed	34	50	
Rough tridens		34	
Squirrletail	20		
Shrub buckwheat	15	10	3
Globemallow	50	49	0
Ecological Site	Clayloam upland	Clayey slopes	Clayey upland

Results show light to moderate level of grazing use at three locations, close to livestock water supplies, throughout the four month grazing season. Grazed plants will be able to recover as these pastures will not be grazed again for 12-18 months.

Additional utilization/stubble height studies were conducted at random plots in April 2015. Stubble heights which and be used to infer utilization found use was none to slight on tobosa which was the focus of the study. Stubble heights were determined to be adequate to exceed fawning hiding requirements as identified in the Arizona Statewide Pronghorn Management Plan (2011). Stubble height averages ranges from 21.2 to 27.3 inches in the 2015 study which exceeded the minimal requirement of 8 inches for pronghorn antelope fawns.

Table 7. Horseshoe Allotment stubble height study on pronghorn fawning grounds in April 2015.

Pronghorn Fawning Stubble Height Study April 2015		
Joes Hill Pasture 12S (0403956, 3783387) NAD 83 South (180) Transect		
PLMU avg. height (in)	27.3	Notes: Cows present in general area. No use on any perennial grasses.
Joe's Hill Pasture NAD 83 12 S (0403956, 3783387) 2 pace North (0)		
PLMU avg. height (in)	25.9	none to little use on PLMU. Other grass sp. had utilization est 60%
New Mill Pasture NAD 83 12S (0405465, 3786069) West (270) Transect		
PLMU avg. height (in)	25.7	PLMU no utilization observed on any grass species
New Mill Pasture 12S (0405465, 3786069) NAD83 East (90)		
PLMU avg. height (in)	27.3	Little to no use on PLMU. Slight use on DICA. Pronghorn sign.
New Mill Pasture 12S (0406445, 3786305) NAD83 Southeast (160) Transect		
PLMU avg. height (in)	21.2	Very little utilization observed
New Mill Pasture 12S(0406443, 3786305) NAD 83 North (0) Transect		
PLMU avg. height (in)	26	No utilization observed on any grass species

6.3 AIM Plots

Thirty two AIM plot locations were randomly selected on the Horseshoe Allotment and vegetative measurements were taken in 2012 and 2018 (Map 2). Seventeen primary AIM plots were selected for repeat measurements on the Allotment. Fifteen backup AIM plots can be used as needed to monitoring progress in meeting land health objectives. Soil cover / vegetation measurements including, ground cover, foliar cover, basal and canopy gap and shrub density were collected at all AIM plots. All primary AIM plots were assessed for Rangeland Health in 2012 or 13. Four primary AIM plots were re-assessed and four backup AIM plots were assessed for Rangeland Health during field studies in 2014.

7.0 Riparian Resources

Riparian resources within the Horseshoe Allotment were assessed in the Agua Fria River, Silver Creek, Bishop Creek and Indian Creek. Quantitative methods assessed species composition, utilization, bank alteration, greenline to greenline width, wetland stability, and ecological ratings. Qualitative monitoring of riparian areas, PFC assessments, are summarized respective to each respective riparian segment.

Riparian monitoring was carried out using BLM Technical Reference 1737-23 Multiple Indicator Monitoring (MIM) of Stream Channels and Streamside Vegetation, 1737-8 Greenline riparian-wetland monitoring: Riparian area management, and BLM Technical Reference 1737-11 Process for Assessing Proper Functioning Condition (PFC) within riparian areas of the Horseshoe Allotment (Map 2). These monitoring methods were selected because they are widely accepted and quantitative methods such as 1737-23 and 1737-8 inform PFC assessments which are qualitative.

The MIM protocol is a quantitative assessment designed for monitoring stream banks, stream channels, and streamside riparian vegetation. The MIM protocol integrates annual grazing use and long-term trend indicators allowing for evaluation of livestock grazing management.
Woody species transects were adopted from technical reference 1737-8 to supplement the MIM protocol in some areas. This was done to capture broader flood plain characteristics for woody species composition. It was only

conducted when the greenline to greenline width assessed in the MIM protocol was too narrow to capture additional riparian obligate species in abandoned channels or on terraces.

The Proper Functioning Condition (PFC) assessment is a qualitative assessment that determines the on-the-ground condition of a riparian area; termed PFC, the protocol is used to assess how well the physical processes are functioning. The protocol is a consistent approach for considering hydrology, vegetation, and erosion/deposition (soils) attributes and processes to assess the condition of riparian-wetland areas. When in a proper functioning state, a riparian area will exhibit resiliency that will allow a riparian-wetland area to hold together during high-flow events with a high degree of reliability. High resiliency allows an area to maintain or produce desired values, such as fish habitat, neotropical bird habitat, or forage, over time. Riparian-wetland areas that are not functioning properly may not sustain these values.

8.0 Land Health Standards, Management Evaluation, and Conclusions

The following are the Arizona Land Health Standards:

Standard 1 - Upland Sites
Upland soils exhibit infiltration, permeability and erosion rates that are appropriate to soil type, climate and landform (ecological site).

Standard 2 - Riparian –Wetland Sites
Riparian-wetland areas are in proper functioning condition.

Standard 3 - Desired Resource Conditions
Productive and diverse upland and riparian-wetland plant communities of native species exist and are maintained.

8.1 Management Evaluation

Upland Sites and Desired Resource Conditions

Photo 9. Range Health Assessment at AIM plot BH-2B, Volcanic Hills, clayey, Boone Tank.

Rangeland Health Assessments must be made on upland ecological sites using the procedures outlined in the interagency handbook “Interpreting Indicators of Rangeland Health” Version 4 (USDI, BLM, 2005) or subsequent versions. Seventeen indicators which apply to three attributes of the range ecosystem are rated to determine the

ecological status of the area. The three attributes are Site and Soil Stability, Hydrologic Function, and Biotic Integrity. Ratings are based on the preponderance of evidence. Rangeland Health Assessments done by BLM in 2012 and 13 were not performed using reference area information as none had been published by NRCS for major ecological sites on the Allotment.

Field investigations in 2014 found that some of the AIM plot locations actually crossed ecological site boundaries complicating prior assessments. Upland Rangeland Health (RH) Assessments were made at all 17 primary AIM plot locations in the winter of 2012 and 2013 by BLM staff. Four primary AIM plot locations and four secondary AIM plot locations were assessed in the summer of 2014 by BLM, TNC, AGFD and Robinett Rangeland Resources (RRR) LLC to determine ecological site designations and use RH reference area information being developed by NRCS. Two additional areas of Clayey Uplands on the northern part of the Allotment were assessed in 2014 as this ecological site was under-represented in the AIM plot random design. Draft NRCS range health reference worksheets were used by RRR LLC for Clayey Upland and Volcanic Hills, Clayey ESDs.

Upland Range Health Assessments done at 19 locations on the Horseshoe Allotment from 2012 to 2014 show that the vast majority of the Allotment meets Rangeland Standard Number 1 (Table 8). Upland soils exhibit infiltration, permeability and erosion rates that are appropriate to soil type, climate and landform (Ecological site). One range health assessment on Volcanic Upland on the Horseshoe Allotment did not meet standard 1. This site appears to be a former cultivated field associated with one of numerous archaeological sites on Perry Mesa. Gullies and rills on the site are thought to be associated with past cultivation.

Table 8. Horseshoe Allotment summary of upland rangeland health assessments.

Horseshoe Allotment Summary of Upland Rangeland Health Assessment							
Plot	Pasture	Eco. Site	Soil & Site Stability	Hydrologic Function	Biotic Integrity	Range Health Assessment	Notes
Not AIM	Copper Trap	Clayey	Stable	Functioning	Intact	Meet Standard 1	
Not AIM	Boone	Clayey	Stable	Functioning	Intact	Meet Standard 1	
Not AIM	Bull	Clayey	Stable	Functioning	Intact	Meet Standard 1	
VU-11	Joe's Hill	Volcanic Upland/Clayey Upland	Stable	Functioning	Intact	Meet Standard 1	
CU-12	Joe's Hill	Clayey	Stable	Functioning	At Risk	Meet Standard 1	Fire-drought invasive annuals
VU-3	Joe's Hill	Volcanic Upland/Clayey Upland	Stable	Functioning	Intact	Meet Standard 1	
VU-7	Lousy	Volcanic Upland/Clayey Upland	Stable	At Risk	At Risk	Meet Standard 1	Arch Site/Cultivated Area
GH-2	North River	Granitic Hills	Stable	Functioning	Intact	Meet Standard 1	Lehmann's lovegrass
GH-2B	South River	Granitic Hills	Stable	Functioning	Intact	Meet Standard 1	Lehmann's lovegrass
VH-5	Boone	Volcanic Upland	Stable	Functioning	Intact	Meet Standard 1	Agave toumeyana site
CU-4B	Joe's Hill	Volcanic Upland	Stable	Functioning	At Risk	Meet Standard 1	Fire-drought invasive annuals
CU-12	Joe's Hill	Volcanic Upland	Stable	Functioning	At Risk	Meet Standard 1	Fire-drought invasive annuals
VU-2	Joe's Hill	Volcanic Upland	Stable	Functioning	At Risk	Meet Standard 1	Fire-drought invasive annuals
VU-4	Joe's Hill	Volcanic Upland	Stable	Functioning	Intact	Meet Standard 1	
VU-5	Lousy	Volcanic Upland	Stable	Functioning	Intact	Meet Standard 1	
VH-12	Boone	Volcanic Hills, Clay	Stable	Functioning	Intact	Meet Standard 1	
VH-8	Double Tank	Volcanic Hills, Clay	Stable	Functioning	Intact	Meet Standard 1	
VH-11	Joe's Hill	Volcanic Hills, Clay	Stable	Functioning	Intact	Meet Standard 1	
VU-6	Joe's Hill	Volcanic Hills, Clay	Stable	Functioning	Intact	Meet Standard 1	
VH-9	Lousy	Volcanic Hills, Clay	Stable	Functioning	Intact	Meet Standard 1	

Desired Resource Conditions
The following Desired Plant Community objectives are outlined in the Agua Fria Resource Management Plant (BLM 2010):

VM-1. Maintain, restore, or enhance the diversity, distribution, and viability of populations of native plants, and maintain, restore, or enhance overall ecosystem health.

VM-2. The distribution and abundance of invasive plants will be contained, and through active management, the impact of invasive species on native ecosystems will be reduced from current levels.

VM-3. All upland areas will include:

- A plant community that consists of native perennial grass and ground cover adequate to improve wildlife habitat and
- Improved watershed function based on monitoring and ecological site potential. Upland sites include five percent or greater dry-weight composition of native perennial grass, as limited by the potential of the ecological site as described by the Natural Resources Conservation Service (NRCS) ecological site guides.

VM-4. The desired plant community for upland sites will have a long-term stable population of columnar cacti and paniculate agave, where the sites have the potential for such plant communities.

Desired plant communities for dominant ecological sites on the Horseshoe Allotment are described by evaluating field vegetation data collected from AIM plot locations and Range trend monitoring locations. These data were then compared to reference conditions from published NRCS ESDs.

Clayey Upland 12-16" pz.

Photo 12. Perry Mesa, Clayey Uplands in good ecological condition. Looking south to the New River Mountains.

Photo 10. Perry Mesa, Clayey Uplands in good ecological condition. South view toward New River Mountains.

This ecological site is described by NRCS as a warm season (C-4) grassland dominated by tobosa with an important component of native annual grasses and forbs (both cool and warm season species). Shrubs, sub-shrubs, succulents

and other plant functional groups are all minor components of the potential native plant community. McAuliffe and King (2010) used repeat aerial photography to document a history of land use and vegetative changes over time on Black Mesa. Their study site, located a few miles to the southwest of the Horseshoe Allotment, consisted of a complex of Clayey Upland and Volcanic Upland ecological sites (Rimrock – Graham soil mapping unit). Although they recognized variability in the soils (rockiness) they did not recognize two ecological sites as occurring on the mesa. Their conclusions were that the potential plant community on Black Mesa consisted of tobosa grassland with few shrubs, but with a sizeable component of prickly pear species. McAuliffe and King found the largest component of prickly pear on the rockiest areas (the Volcanic Upland part of the complex) on Black Mesa. The ESD for Clayey Upland (R038XA102AZ) shows a plant community with tobosa> native annual forbs and grasses> perennial forbs> other perennial grasses> shrubs and succulents. Succulents like the prickly pear species can make up from 0 to 5% of the species composition by weight. Annual production on this site varies from 600 lbs/ac (air dry) in drought years to 2000 lbs/ac in wet years as shown on the NRCS ESD.

At present nearly all of the areas of this site on the Horseshoe Allotment in the Bull, Boone Tank, Double Tanks and New Well pastures are similar in condition to the potential plant community as described in the ecological site description. Non-native annual forbs and grasses now occur everywhere on the Allotment. These species include filaree (*Erodium cicutarium*), red brome (*Bromus rubens*), wild oats (*Avena fatua*), foxtail barley (*Hordeum leporinum*) and tumble mustard (*Sysimbrium spp*.). In most places these species have blended with the native annual component of the plant community. In the Lousy and west side of the Joe's Hill pasture, wild oats has become dominant on areas of this site and tobosa grass cover is greatly reduced. In the same two pastures large shrubs like catclaw acacia and mimosa are increasing on some areas of this site from adjacent areas of Volcanic Uplands with shallow soils. The loss of tobosa and increase in dominance by invasive annuals (especially wild oats) has been investigated on Black Mesa to the southwest of Joe's Hill (McAuliffe and King, 2010). On Black Mesa high fine fuel loads after the (El Nino) wet winter of 2005, wildfire and severe drought and high temperatures from 1995 through 1998 resulted in tremendous loss of tobosa cover. Prescribed fire around Joe's Hill during the same time period coupled with the movement of wild oats (SW prevailing winds) from Black Mesa appears to be the casual factor in the vegetative change occurring in these two pastures on the Horseshoe Allotment. Tobosa has low palatability for grazing livestock. In addition these areas have experienced very little grazing use during the past 10 years and it appears that vegetative change is being driven by the interaction of fires (both prescribed and wild), drought and the presence of invasive annual grasses.

In areas of Clayey Upland in the northern part of the Allotment prescribed fires in both 2010 and 2011 burned with high fuel loads and were followed by dry years resulting in loss of tobosa cover. The 2017 Brooklyn Fire burned most of southern and central part of the Allotment. Rain gauges placed on the Allotment recorded less than 2 inches of rain between July 2017 and July 2018. In some areas large bare patches are interspersed with tobosa patches. Bestelmeyer and colleagues (2006) found that soil aggregate stability was significantly reduced in bare patches as compared to tobosa grass patches on the Jornada Experimental Range in the Chihuahuan Desert. In this same area on clayey soils, monitoring has shown bare patches to be persistent and tobosa basal cover of 4% after drought could recover to 10% with more normal precipitation (Bestelmeyer, 2014). The desired plant community for the Clayey Upland ecological site should be tobosa grassland with a sizeable component of native annual forbs and grasses (Table 9). Tobosa grass cover increased in 2018 compared to 2012 despite the 2017 Brooklyn Fire within Clayey Upland sites of the Horseshoe Allotment.

Table 9. Summary of cover categories from 2012 and 2018 for Clayey Upland ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Summary Category	2012 Average Percent	2018 Average Percent	NRCS ESD
Foliar Cover All	36.3	33.2	45-119%
Foliar Tobosa	6.9	17.2	5-20%
Bare Ground	20.9	27.9	15-25%
Basal Cover	1.7	1.0	12-31%
Total Litter	50.0	38.7	35-55%
Gravel/Rock	4.3	4.4	0-25%

Table 9 shows the relationship of cover categories found in the field in 2012 compared to 2018 relative to the NRCS ESD. *Foliar cover includes multiple height classes and therefore can be over 100%.

Desired Resource Conditions are shown in Table 10 for Clayey Upland ecological site on the Horseshoe Allotment. These show a range in values from disturbance like fire, back to equilibrium conditions and from drought to average year precipitation.

Table 10. Summary of desired resource condition categories and objectives for Clayey Upland ecological sites on the Horseshoe Allotment.

Categories	Objective
Foliar Cover Tobosa	5-20%
Bare Ground	15-25%
Basal Cover	4-10%
Total Litter	25-45%
Gravel/Rock	2-25%
Annual Production	600-2000 lbs/ac

Volcanic Upland 12-16" pz.

Photo 11. Volcanic Upland in good ecological condition, Bull pasture. Prescribed fire in 2010.

This ecological site is described by NRCS as a diverse plant community dominated by perennial grasses (including tobosa) with an important component of native annual grasses and forbs (both cool and warm season species). Sub-shrubs, large shrubs, perennial forbs and succulents are important components of the potential native plant community. McAuliffe and King (2010) used repeat aerial photography to document a history of land use and vegetative changes over time on Black Mesa. Their study site, located a few miles to the southwest of the Horseshoe Allotment, consisted of a complex of Clayey Upland and Volcanic Upland ecological sites (Rimrock – Graham soil mapping unit). Although they recognized variability in the soils (rockiness) they did not recognize two ecological sites as occurring on the mesa. Their conclusions were that the potential plant community on Black Mesa consisted of tobosa grassland with few shrubs, but with a sizeable component of prickly pear species. McAuliffe and King (2010) found the largest component of prickly pear on the rockiest areas (the Volcanic Upland part of the complex) and little to no large shrub (catclaw and mimosa) cover on Black Mesa in their earliest photos. They conclude that large shrubs that are present today, invaded the gently sloping area of Clayey Upland / Volcanic Uplands on top of the mesa from the adjacent steep slopes of Volcanic Hills.

They suggest this was due to increased grazing use of Black Mesa from 1940 through 2009 due to increasing density of water facilities over this time. This analysis may not hold true in the southern part of Perry Mesa on the Horseshoe Allotment. Here the development of livestock water is primitive (3 dirt tanks) and the density of livestock water is very low compared to Black Mesa. The Volcanic Uplands in this part of Perry Mesa all have sizeable components of large shrubs. Perhaps the reasons for increase in large shrubs are driven by climate (warming) rather than by livestock grazing pressure. The ESD for Volcanic Upland (R038XA115AZ) shows a plant community dominated by perennial grasses, sub-shrubs, perennial forbs and with native annual forbs and grasses making up from 5 to 30% of the species composition by weight. Large shrubs like catclaw and mimosa can make up from 4-7% and succulents like prickly pear can make up from 2 to 4% of the species composition by weight. Annual production of the plant community varies from 300 lbs/ac (air dry) in drought years to over 1,300 lbs/ac in wet years.

At present nearly all of the areas of this site on the Horseshoe Allotment in the Bull, Boone Tank, Double Tanks and New Well pastures are similar in condition to the potential plant community as described in the ecological site description (Table 11). Non-native annual forbs and grasses now occur everywhere on the Allotment. In most places these species have blended with the native annual component of the plant community. In the Lousy and west side of

the Joe's Hill pasture wild oats has become dominant on areas of this site and perennial grass cover is greatly reduced. In the same two pastures large shrubs like catclaw acacia and mimosa appear to be increasing on areas of this site. The loss of perennial grasses and forbs and increase in dominance by invasive annuals (especially wild oats) has been investigated on Black Mesa to the southwest of Joe's Hill (McAuliffe and King, 2010). Prescribed fire around Joe's Hill during the same time period coupled with the movement of wild oats (SW prevailing winds) from Black Mesa appears to be the casual factor in the vegetative change occurring in these two pastures on the Horseshoe Allotment. These areas have experienced very little grazing use during the past 10 years and it appears that vegetative change is being driven by the interaction of fires (both prescribed and wild), drought and the presence of invasive annual grasses. Because of the interactions of fire and drought, annuals species are absent from the 2018 data results.

Table 11. Summary of functional group categories from 2012 and 2018 AIM data for Volcanic Upland ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Functional Group	2012 Percent Cover	2018 Percent Cover	NRCS ESD
Grass	8.8	11.3	17-51%
Forb	5.1	0.0	1-20%
Shrub/Vines	10.5	5.5	12-35%
Tree	5.4	7.3	0-3%
Red Brome	11.0	0.0	0.0
Wild Oats	0.7	0.0	0.0

Table 11 shows summary data from 16 Volcanic Upland sites where foliar cover data was collected from AIM plots on the Horseshoe Allotment. It also compares this data to that shown on the NRCS ESD for Volcanic Upland (R038XA115AZ).

Table 12. Summary of cover categories from 2012 and 2018 AIM data for Volcanic Upland ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Summary Category	2012 Average Percent	2018 Average Percent	NRCS ESD
Foliar Cover	43.5	23.3	16-40%
Bare Ground	21.4	39.6	5-55%
Basal Cover	3.5	0.0	3-8%
Total Litter	48.3	29.2	10-35%
Gravel/Rock	3.1	5.1	36-75%

Table 12 shows the relationship of cover categories found in the field (present) to those shown on the NRCS ESD. The desired plant community for the Volcanic Upland ecological site should be a diverse community with perennial grasses > native annual forbs and grasses> sub-shrubs> large shrubs> perennial forbs> succulents.

Desired Resource Conditions are shown in Table 13 for Volcanic Upland ecological site on the Horseshoe Allotment. These show a range in values from disturbance like fire, back to equilibrium conditions and from drought to average year precipitation.

Table 13. Summary of desired resource condition categories and objectives for Volcanic Upland ecological sites on the Horseshoe Allotment.

Categories	Objective
Foliar Cover	16-40%
Bare Ground	5-55%
Basal Cover	4-14%
Total Litter	10-40%
Gravel/Rock	36-75%
Annual Production	300-1335 lbs/acre

Volcanic Hills, Clayey 12-16" pz.

This ecological site is described by NRCS as a diverse plant community dominated by perennial grasses (including tobosa) with an important component of native annual grasses and forbs (both cool and warm season species). Sub-shrubs, large shrubs, trees, perennial forbs and succulents are important components of the potential native plant community. McAuliffe and King (2010) used repeat aerial photography to document a history of land use and vegetative changes over time on Black Mesa. Their study site, located a few miles to the southwest of the Horseshoe Allotment, consisted of a complex of Clayey Upland and Volcanic Upland ecological sites (Rimrock – Graham soil mapping unit). In their assessment of historic vegetative conditions they determined that the steeper slopes associated with the top of Black Mesa always had a diverse plant community including shrubs, succulents and trees.

The ESD for Volcanic Hills, Clayey (R038XA117AZ) shows a plant community dominated by perennial grasses, sub-shrubs, perennial forbs and with native annual forbs and grasses making up from 5 to 20% of the species composition by weight. Large shrubs species are numerous and can make up from 5-10% and succulents like prickly pear, banana yucca and agave can make up from 3 to 8% of the species composition by weight. Trees are common on north exposures and can be 0-5% of the composition by weight. Annual production of the plant community varies from 700 lbs/ac (air dry) in drought years, 1,200 in average rainfall years to 2,000 lbs/ac in wet years.

Photo 12. Volcanic Hills, Clayey in good ecological condition. Near Bob's Tank in Joe's Hill pasture.

At present nearly all of the areas of this site on the Horseshoe Allotment in the Bull, Boone Tank, Double Tanks and New Well pastures are similar in condition to the potential plant community as described in the ecological site

description. In some places large shrubs like catclaw acacia, velvet mesquite (*Prosopsis velutina*) and mimosa appear to be increasing on areas of this site. This is probably due to climatic warming as these species sprout vigorously after fire and livestock grazing does not appear to have been heavy enough to affect the plant community on these steep and rocky slopes. On north exposures at the higher elevations of this site, redberry juniper may be increasing as plant communities have many young trees in them. Fire may be important in the management of this tree species.

Table 14. Summary of functional group categories from 2012 and 2018 AIM data for Volcanic Hills, clayey ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Functional Group	2012 Percent Cover	2018 Percent Cover	NRCS ESD
Grass	14.1	23.2	22-45%
Forb	2.4	1.2	1-7%
Shrub/Vines	26.5	19.6	12-32%
Tree	6.6	8.5	0-15%
Red Brome	15.0	0.0	0.0
Wild Oats	0.2	0.0	0.0

Table 14 shows the relationship of percent foliar cover categories found in the field on 8 Volcanic Hills, Clayey sites to the same categories as shown on the NRCS ESD.

Table 15. Summary of cover categories from 2012 and 2018 AIM data for Volcanic Hills, clayey ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Cover Categories	2012 Average Percent	2018 Average Percent	NRCS ESD
Foliar Cover	51.4	46.4	35-99%
Bare Ground	10.5	10.8	5-20%
Basal Cover	3.4	0.0	n/a
Total Litter	44.2	58.6	10-45%
Gravel/Rock	7.0	9.8	35-90%

Table 15 shows the summary data from 8 Volcanic Hills, Clayey sites where foliar cover data were collected from AIM plots on the Horseshoe Allotment. It also compares these data to that shown on the NRCS ESD for Volcanic Hills, Clayey (R038XA117AZ). The desired plant community for the Volcanic Hills, Clayey ecological site should be a diverse community with perennial grasses > sub-shrubs > large shrubs > native annual forbs and grasses > perennial forbs > succulents > trees.

Desired Resource Conditions are shown in Table 16 for Volcanic Hills, Clayey ecological site on the Horseshoe Allotment. These show a range in values from disturbance like fire, back to equilibrium conditions, from drought to average year precipitation and from north to south aspects.

Table 16. Summary of desired resource condition categories and objectives for Volcanic Hills, clayey ecological sites on the Horseshoe Allotment.

Cover Categories	Objectives
Foliar Cover	20-40%
Bare Ground	5-20%
Basal Cover	5-20%
Total Litter	10-45%
Gravel Rock	35-90%
Annual Production	670-2000 lbs/acre

Granitic Hills 12-16" pz.

This ecological site is described by NRCS as a diverse plant community dominated by perennial grasses and forbs. Sub-shrubs, large shrubs, succulents and trees are important components of the potential native plant community. Due to shallow, coarse textured soils this ecological site has a minor component of native annual grasses and forbs.

The ESD for Granitic Hills (R038XA104AZ) shows a plant community dominated by perennial grasses, sub-shrubs and large shrubs. Perennial forb species are numerous and can make up from 1-6% of the species composition by weight. Succulent species like prickly pear, banana yucca, hedgehog and cholla can make up from 1 to 10% of the species composition by weight. Trees are common on north exposures and are from 0-10% of the species composition by weight. Native annual forbs and grasses make up less than 5% of the species composition by weight. Annual production of the plant community varies from 335 lbs/ac (air dry) in drought years, 720 in average rainfall years to 1,600 lbs/ac in wet years.

At present the areas of this site on the Horseshoe Allotment are similar in condition to the potential plant community as described in the ecological site description except that plant functional groups perennial grasses and sub-shrubs have switched dominance. Sub-shrubs are now dominant and perennial grasses sub dominant. Since grazing has not been a recent factor in the North and South River pastures this switch is probably due to steep declines in warm season precipitation and increasing summer temperatures over the past 17 years. The dominant sub-shrubs are cool season plants while the dominant perennial grasses are warm season plants. Wait-a-bit mimosa appears to be increasing in areas of this site. This may be driven by increases in winter temperatures. It is probably not related to historic livestock grazing or lack of fire in the area as it appears to be a region-wide trend and mimosa sprouts vigorously after fire.

Photo 13. Granitic Hills in good ecological condition. North and south aspects in South River pasture.

Table 17. Summary of functional group categories from 2012 and 2018 AIM data for Granitic Hills ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Functional Group	2012 Percent	2018 Percent	NRCS ESD
Perennial Grass	4.3	10.2	0-1%
Annual Grass/Forbs	0.3	3.7	0-1%
Shrubs/Succulents	30.2	57.2	65-85%
Trees	2.7	0	5-15%
Snakeweed	6.3	10.2	0-1%
Red Brome	18.7	0	0
Wildoats	0	0	0

Table 17 shows the relationship of percent foliar cover categories found in the field on 2 Granitic hills sites to the same categories as shown on the NRCS ESD.

Table 18. Summary of cover categories from 2012 and 2018 AIM data for Granitic Hills ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Cover Category	2012 Percent Cover	2018 Percent Cover	NRCS ESD
Foliar Cover	48.0	62.3	70-103%
Bare Ground	19.3	3.7	5-10%
Basal Cover	0.7	0.3	5-10%
Total Litter	47.7	71.7	60-80%
Gravel/Rock	29.7	87.7	5-60%

Table 18 shows the summary data from 2 Granitic Hill sites where foliar cover data were collected from AIM plots on the Horseshoe Allotment. It also compares these data to that shown on the NRCS ESD for Granitic Hills (R038XA104AZ). The desired plant community for the Granitic Hills ecological site should be a diverse community with shrubs > trees > succulents > sub-shrubs > annual forbs > annual grasses > perennial grass. *Foliar cover includes multiple height classes and therefore can be over 100%.

Desired Resource Conditions are shown in Table 19 for Granitic Hills ecological site on the Horseshoe Allotment. These show a range in values from disturbance like fire, back to equilibrium conditions, from drought to average year precipitation and from north to south aspects.

Table 19. Summary of desired resource condition categories and objectives for Granitic Hills ecological sites on the Horseshoe Allotment.

Cover Category	Objectives
Foliar Cover	60-100%
Bare Ground	5-10%
Basal Cover	5-10%
Total Litter	60-80%
Gravel/Rock	5-60%
Annual Production	805-1827 lbs/acre

Clayey Slopes 12-16" pz.

This ecological site is described by NRCS as a diverse plant community dominated by perennial grasses (including tobosa) with an important component of native annual grasses and forbs (both cool and warm season species). Sub-shrubs, large shrubs, trees, perennial forbs and succulents are important components of the potential native plant community.

The ESD for Clayey Slopes (R038XA108AZ) shows a plant community dominated by perennial grasses, sub-shrubs, perennial forbs and with native annual forbs and grasses making up from 2 to 20% of the species composition by weight. Large shrubs species are can make up from 1-10% and succulents like prickly pear, banana yucca and agave can make up from 1 to 5% of the species composition by weight. Trees are common on north exposures and can be 0-5% of the composition by weight. Annual production of the plant community varies from 360 lbs/ac (air dry) in drought years, 800 lbs/ac in average rainfall years to 1,450 lbs/ac in above average years.

Table 20. Summary of functional group categories from 2012 and 2018 AIM data for Clayey slopes ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Functional Group	2012 Percent	2018 Percent	NRCS ESD
Grasses	36.7	47.7	16-45%
Forbs	0.6	3.1	1-32%
Shrubs/Succulents	16.1	22.9	5-24%
Trees	11.5	16.0	0-7%
Tobosa	13.5	32.9	15-35%
Snakeweed	2.0	2.4	0-1%
Red Brome	17.3	0	0.0

Table 20 shows the relationship of percent foliar cover categories found in the field on 3 Clayey Slopes sites to the same categories as shown on the NRCS ESD. The desired plant community for the Clayey Slopes ecological site

should be a diverse community with perennial grasses > sub-shrubs > large shrubs > native annual forbs and grasses > succulents > perennial forbs > trees

Table 21. Summary of cover categories from 2012 and 2018 AIM data for Clayey Slopes ecological sites and their associated reference ecological site description on the Horseshoe Allotment.

Summary Category	2012 Percent	2018 Percent	NRCS ESD
Foliar Cover	49.6	72.0	22-108%
Bare Ground	24.2	0.9	5-35%
Basal Cover	3.3	0.0	8-19%
Total Litter	46.4	84.0	15-65%
Gravel/Rock	16.4	90.2	46-50%

Table 21 shows the summary data from 3 Clayey Slopes sites where foliar cover data were collected from AIM plots on the Horseshoe Allotment. It also compares these data to that shown on the NRCS ESD for Clayey Slopes (R038XA108AZ).

Desired Resource Conditions are shown in Table 22 for Clayey Slopes ecological site on the Horseshoe Allotment. These show a range in values from disturbance like fire, back to equilibrium conditions, from drought to average year precipitation and from north to south aspects.

Table 22. Summary of desired resource condition categories and objectives for Clayey Slopes ecological sites on the Horseshoe Allotment.

Summary Category	Objectives
Foliar Cover	50-75%
Bare Ground	5-35%
Basal Cover	1-5%
Total Litter	15-65%
Gravel/Rock	50-85%
Production	360-1450 lbs/acre

Riparian Resources

Proper Functioning Condition Assessments

Proper functioning conditions assessments were conducted in the Horseshoe Allotment since the early 1990s. Assessments have been conducted on all designated riparian areas within the Horseshoe Allotment. Many of the segments were determined to be Functional at Risk (FAR). Causal factors for the "at risk" were livestock, particularly in the 1990s, and the Cave Creek Complex fire which impacted Silver Creek in 2005 and the years after.

Table 23. Proper Functioning Condition Assessments.

Agua Fria River Segment	Length (BLM/Private)	Year	Rating	Comments
1N	3.3/0.6	1991	Satisfactory	
		1995	FAR N/A	
		1998	FAR Upward trend	Urbanization within watershed and road crossing
		2013	FAR Upward trend	Ground water pumping and drought
1M	3.0/0	1991	Satisfactory	
		1998	FAR Upward trend	
		2006	FAR N/A	
Bishop Creek Segment	**Length (BLM/Private)**			
42A	2.0/0	2006	PFC	
		2013	PFC	
Indian Creek Segment	**Length (BLM/Private)**			
44A	2.1/0	1992	Unsatisfactory	
		1995	FAR NA	Stable Condition
		1998	FAR Upward trend	
		2013	FAR NA	Ground water pumping, drought
Silver Creek Segment	**Length (BLM/Private)**			
43A	3.0/0	1992	Satisfactory	
		1995	FAR Upward trend	
		1998	FAR Upward trend	
		2013	FAR Downward Trend	High Sediment Loading from CCC Fire
43B	2.0/0	1992	Unsatisfactory	Cattle Use Casual Factor
		1995	FAR NA	
		1998	FAR Upward trend	
		2013	FAR Downward	Sediment from Cave Creek complex fire
43C	2	1995	FAR NA	Stable Condition
		1998	FAR Upward trend	

Agua Fria River Segment	Length (BLM/Private)	Year	Rating	Comments
		2003	FAR Downward Trend	
		2005	PFC	
		2013	FAR NA	Sediment form Cave Creek Complex Fire
***FAR: Functional At risk, NA: Not Apparent, PFC: Proper Functioning Condition**				

Multiple Indicator Monitoring

Representative Designated Monitoring Areas (DMAs) were selected within the Agua Fria River, Indian Creek, and designated critical habitat within Silver Creek. MIM was not performed at Bishop Creek due to a lack of adequate riparian components to conduct the protocol. At each of the MIM plots, bank stability, bank alterations, greenline width, greenline herbaceous and woody vegetation attributes were recorded. These indicators are used to determine if riparian objectives within the Resource Management Plan are met and to inform quantitative PFC assessments. In the case of critical habitat within Silver Creek, MIM is used to document livestock use within the creek and establish if thresholds set forth by the USFWS Biological Opinion (2241-0-05-F-0785) have been exceeded.

The greenline is a linear grouping of live perennial vascular plants, embedded rock, or anchored wood above the waterline on or near the water's edge. Species composition includes both the perennial vegetation rooted within the frame as well as the mature overstory hanging over the plot. Generally, stream banks are dominated by native grasses, sedges and other riparian obligate species. Woody species include all age classes of willow, cottonwood, seep willow, velvet ash, and other riparian obligate trees with a minor component of salt cedar. In narrow riparian systems such as Indian and Silver Creek, only MIM was used to determine woody species composition. In the broad channel of the Agua Fria River, woody species transects were also conducted to capture trees outside the narrow greenline in PFC segment 6235-1N (Table 24).

Table 24. MIM greenline composition percentages for the Agua Fria River.

PLANT SPECIES COMPOSITION	Common Name	Species Plant Code	Greenline Composition
Agua Fria River 6235-1N: 2012	Seep Willow	BASA4	5.8%
	Spike Rush	ELPA3	4.6%
	Deer Grass	MURI2	0.3%
	No Greenline	NG	0.3%
	Cottonwood	POFR2	44.0%
	Rock	RK	26.5%
	Gooding's willow	SAGO	5.5%
	Three Square	SCPU3	5.1%
	Salt cedar	TARA	0.0%
	Wood	WD	0.1%
	Cattail	TYPHA	8.0%

Table 25. MIM greenline composition percentages for Silver Creek.

PLANT SPECIES COMPOSITION	Common Name	Species Plant Code	Greenline Composition
Silver Creek 6235-1C: 2013	Sedge	CAREX	0.8%
	Spike Rush	ELPA3	18.4%
	Velvet Ash	FRVE2	15.6%
	Deer Grass	MURI	31.3%
	No Greenline	NG	0.0%
	Cottonwood	POFR2	2.5%
	Rock	RK	8.3%
	Three Square	SCPU3	20.7%
	Wood	WD	2.5%

Table 26. MIM greenline composition percentages for Indian Creek.

PLANT SPECIES COMPOSITION	Common Name	Species Plant Code	Greenline Composition
Indian Creek 6235-44A: 2013-2014	Spike Rush	ELPA3	12.8%
	Velvet Ash	FRVE2	24.1%
	Juniper	JUOS	2.5%
	Deer Grass	MURI2	8.5%
	No Greenline	NG	1.3%
	Rock	RK	7.3%
	Gooding's Willow	SAGO	20.0%
	Salt cedar	TARA	0.2%
	Wood	WD	0.1%
	Velvet Mesquite	PRVE	17.4%
	Sycamore	PLWR2	5.4%
	Spiny Hackberry	CEEH	0.2%
	Fremont Barberry	MAFR3	0.2%
	Bermuda grass	CYDA	0.1%

Table 27. MIM woody species age class percentages.

Woody Species Transects Agua Fria River 6235-1N: 2013	Seedling	Young	Mature
AGE CLASS TOTALS	87	73	74
% of TOTAL	37	31	32

Stubble height, an important indicator of use, found that all plots exhibited a "none to slight" use of palatable herbaceous species (Table 28). Spike rush (*Eleocharis palustris*), deer grass (*Muhlenbergia rigens*), common three square (*Schoenoplectus pungens*), were commonly encountered palatable species that were measured. Although not a preferred browse species, cattail (*Typha* sp.) measurements were also recorded. These water adapted plants are necessary to provide bank stabilization and habitat for many wildlife species.

Table 28. MIM stubble height median and mean for all key species.

	Stubble Height			
	MedianSH all key species (cm)	***Average SH for all key species (cm)***	***Dom key species for SH***	***Avg Ht of dom key species***
Agua Fria River 6235-1N: 2012	100.00	105.5	TYPHA	163.57
	n=	38	14	
	95% conf Int1	17.2		22
	95% CI2	**0.96**		
Silver Creek 6235-1C: 2013	25.00	41.9	MURI2	82.93
	n=	81	27	
	95% conf Int1	7.4		10
	95% CI2	**0.96**		
Indian Creek 6235-44A: 2013-2014	41.50	41.8	MURI2	63.63
	n=	32	16	
	95% conf Int1	8.3		5
	95% CI2	**0.96**		

Woody riparian plants contribute to stream banks stability and provide important habitat for wildlife species. Livestock are known to browse on woody species which inhibits recruitment (Leonard et al. 1997). Woody species use is a MIM indicator of grazing utilization on woody species along stream banks. Livestock have not had access to riparian areas within the Horseshoe Allotment since 2005 which is shown in MIM indicator results of slight (0-20%) grazing use of riparian woody species (Table 29).

Table 29. MIM Woody Species Use, Stream bank alteration, and Woody Species Age Class percentages. Confidence intervals are listed in bold.

	Woody Use	Streambanks			Woody Species Age Class		
	Woody Species Use - all woody species (%)	*Streambank Alteration (%)*	*Streambank stability(%)*	*Streambank cover (%)*	*Percent seedlings*	*Percent Young*	*Percent Mature*
Agua Fria River 6235-1N: 2012		0%	93%	44%	54%	46%	0%
	0	49	81	81	245	238	11
		0%	*	*	1		
	5%	**6%**	**5%**	**5%**	**7%**	**7%**	**7%**
Silver Creek 6235-1C: 2013	4.8%	0%	86%	86%	56%	19%	25%
	7	74	74	74	10	4	6
		0%	*	*	1		
	5%	**6%**	**5%**	**5%**	**7%**	**7%**	**7%**
Indian Creek 6235-44A: 2013-2014	10.0%	0%	99%	19%	13%	73%	13%
	44	64	84	84	2	14	2
		0%	*	*			
	5%	**6%**	**5%**	**5%**	**7%**	**7%**	**7%**

Stream bank stability, ecological status rating and wetland rating are determined qualitatively by observing whether the stream banks are depositional or erosional; whether they are covered or uncovered; and whether any type of instability is occurring (i.e. fracturing, slumping, sloughing, or eroding) and the type of vegetation growing along the greenline. For the bank to be considered covered, the stream bank must be covered by at least either 50% foliar cover of perennial vegetation, 50% cover of cobbles 15cm or greater, 50% cover of anchored large woody debris 10 cm diameter or greater, or 50% cover of a combination of the three. These parameters are used to determine ecological status, wetland rating and site stability.

Riparian Desired Resource Conditions

Desired Plant Community for Silver Creek riparian: Overstory dominated by native riparian obligate trees including Fremont cottonwood (*Populus fremontii)*, Gooding's willow (*Salix gooddingii)*, net leaf hackberry (*Celtis reticulate)* and Arizona sycamore (*Platanus wrightii*). Multiple age-classes of riparian trees are present to provide recruitment for maintenance and recovery. The age class distribution should be >15 percent seedlings, > 15 percent young, and >15 percent mature (age class according to BLM Tech Reference 1737-23). Herbaceous riparian streambank vegetation dominated by three square sedge (*Schoenoplectus pungens*), common spikerush (*Eleocharis palustris*), cattail (*Typha latifolia)*, and common reed (*Phragmites australis*).

Desired Plant Community for Indian Creek riparian: Overstory dominated by native riparian obligate trees including Fremont cottonwood, Gooding's willow, velvet ash (*Fraxinus velutina*) and Arizona sycamore. The age class distribution should be >15 percent seedlings, > 15 percent young, and >15 percent mature (age class according to BLM Tech Reference 1737-23). Herbaceous riparian streambank vegetation dominated by three square sedge, cattail, and common reed.

Desired Plant Community for the Agua Fria River: In areas that are less prone to scouring and where there is sufficient soil development and soil moisture the Desired Plant Community consists of herbaceous riparian streambank vegetation dominated by three square sedge, and common spikerush. The riparian overstory is dominated by native riparian obligate tree species including Gooding's willow, velvet ash, and Fremont cottonwood. The age class distribution should be >15 percent seedlings, > 15 percent young, and >15 percent mature (age class according to BLM Tech Reference 1737-23).

Desired Plant Community for Bishop Creek riparian: Overstory dominated by native riparian obligate trees including Fremont cottonwood, Gooding's willow, net leaf hackberry, and Arizona sycamore. Multiple age-classes of riparian trees are present to provide recruitment for maintenance and recovery. The age class distribution should be >15 percent seedlings, > 15 percent young, and >15 percent mature (age class according to BLM Tech Reference 1737-23). Herbaceous riparian streambank vegetation dominated by three square, common spikerush, cattail, and common reed.

8.2 Conclusions

Standard 1 - Upland sites

Standard 1 is being met across the Horseshoe Allotment. Overall, plant communities found on the various ecological sites within the Allotment are in good ecological condition and support adequate soil stability and hydrologic function. Some areas of the Allotment have red brome and other non-native invasive plants within the upland plant communities. This is a common occurrence within most plant communities across Arizona; however, these areas will need special attention as management moves forward due to the impact that invasive species can have on soil stability and hydrologic function. Other areas of the Allotment have moved to a late successional state, which has allowed woody species (e.g. catclaw acacia) to become dominate. These areas will also need special attention as management moves forward because of the impact that they can have on soil stability and hydrologic function. Overall, there is no indication that current livestock grazing is having negative impacts on the upland areas of the Allotment.

Standard 2 - Riparian and wetland sites

Standard 2 is not being met across the Horseshoe Allotment. PFC results determined most riparian areas are "Functioning at Risk." The Agua Fria River is "Functioning at Risk" with no apparent trend. Drought was noted as likely contributing to a lack of proper functioning condition. However, OHV barriers were installed in 2010 which has resulted in improvements in the area. Heavy sediment loads continue to negatively impact Silver Creek as a result of the 2005 Cave Creek Complex fire. Sediment loading will likely continue to decrease as upland and riparian areas become vegetated and stable. PFC data also shows that groundwater pumping and drought are likely having an impact on Indian Creek.

MIM data shows that the riparian resources within the Allotment have good age class diversity, including excellent recruitment numbers. MIM data also shows that there is good biodiversity of desired species within riparian areas. MIM data also shows good recruitment of riparian vegetation, good stream bank stability, and low stream bank alteration. Overall, there is no indication that current livestock grazing management is having any negative impacts on the riparian areas within the Allotment. Avoidance of grazing during the growing seasons (March 1 – November 1) would continue to benefit the riparian plant communities.

Standard 3 - Desired Resource Conditions

Standard 3 is being met in most of the upland areas on the Horseshoe Allotment. The area of Clayey Uplands and Volcanic Uplands in the western part of Joe's Hill and in the Lousy pastures are being compromised by drought, fire and the invasion of non-native annuals especially wild oats, red brome and black mustard. These species affect the ability of plant functional groups like perennial grasses, sub-shrubs and perennial forbs to recover on these two ecological sites after disturbance like drought and fire.

Standard 3 is being met in all of the riparian areas within the Allotment. Riparian areas within the Allotment should be dominated by native woody and herbaceous vegetation, which they currently are. The age class distribution of native riparian vegetation should be >15 percent seedlings, > 15 percent young, and >15 percent mature (age class according to BLM Tech Reference 1737-23). Looking at the MIM data, all of the riparian areas within the Allotment meet, or are making significant progress towards meeting vegetation distribution percentages.

9.0 Management Recommendations

Fire management should include aggressive suppression of all wildfires especially in the southwestern part of the Allotment where non-native and invasive annuals are spreading. Targeted grazing could be evaluated in this area to break up the continuity of fine fuels resulting from heavy infestations of wild oats, red brome and black mustard. Both methods would assist in the maintenance of perennial grass cover.

The livestock water developments across much of the Allotment are dirt tanks which are not reliable sources. Efforts should be made to develop reliable water sources including water wells, catchments and storage tanks with pipelines and troughs. Effective livestock grazing management is only possible with reliable sources of water spaced evenly across the accessible (for cows) areas of rangeland.

The proposed grazing system using one herd moving in rotation through pastures should be adopted. Rest periods after a pasture is grazed should be from 12 to 24 months depending on climatic conditions and forage plant recovery. The system should allow flexibility in livestock grazing use and accommodate longer rest periods that might be needed after severe disturbance like fire.

Actual use records including animal numbers, dates in pastures should be turned into the BLM within 15 days of the end of the grazing season, or when the permittee removes their cattle.

Utilization studies should be conducted each year by the interdisciplinary (ID) team at random locations within a half mile of available water at the end of the grazing period or the end of the grazing year (May-June).

An adaptive management process should be codified within the CRMP framework to allow for yearly review of all activities on the Allotment and to incorporate monitoring results into the process to refine applied management. Long term monitoring should be repeated accordingly to management goals.

Silver Creek should be fenced to exclude livestock grazing to expedite recovery from the Cave Creek Complex Fire and heavy sediment loads. Hardened crossing site(s) should be used to allow livestock to move across Silver Creek within Boone Pasture.

10.0 List of Preparers

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11.0 Interagency Review

An interagency review of the preliminary version of this LHE was completed by the Horseshoe-Copper Creek Coordinated Resource Management Plan Land Use Committee. The committee was comprised of members from

various state and federal natural resource management agencies. Comments provided to the BLM from the preliminary review were incorporated into this draft LHE.

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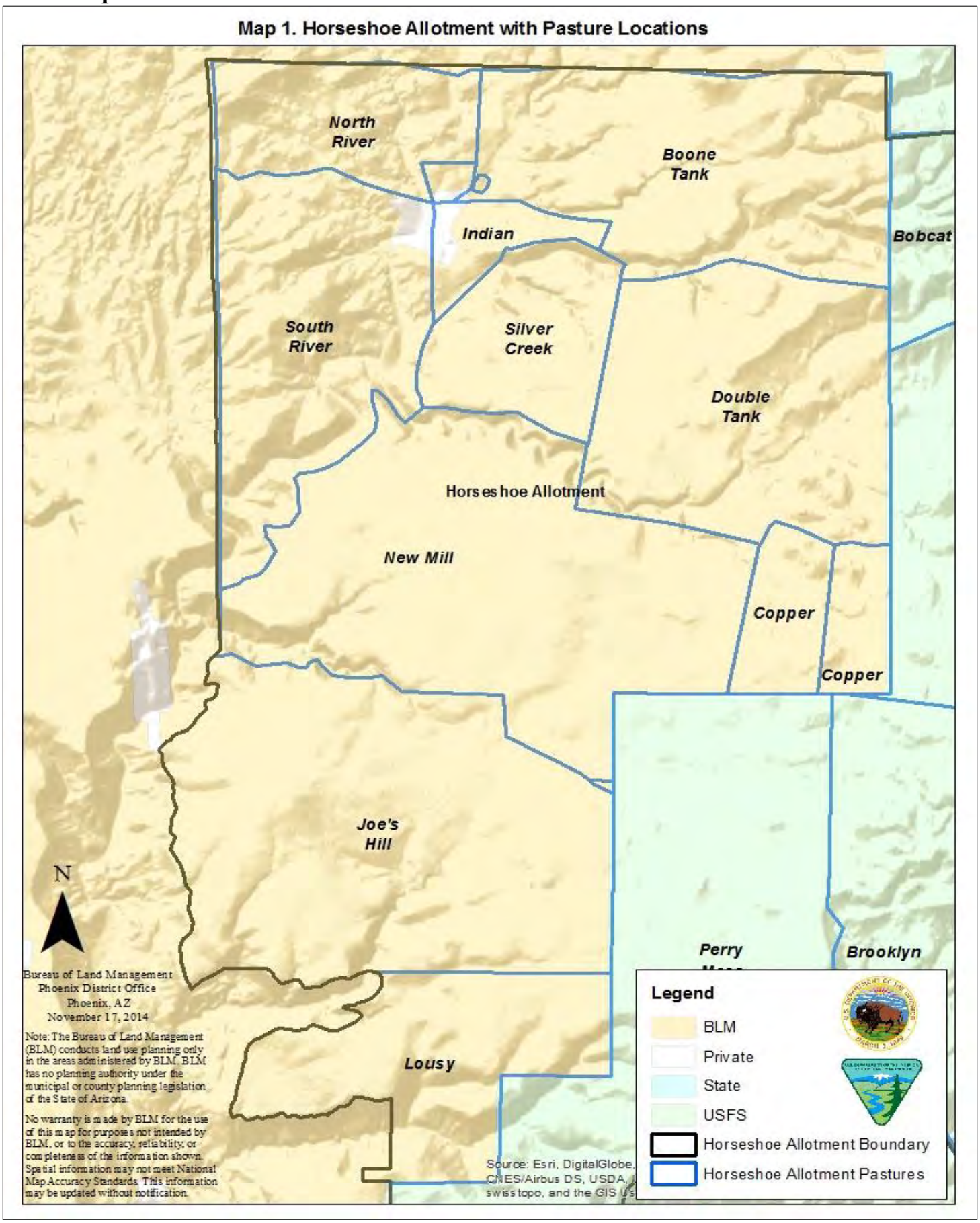
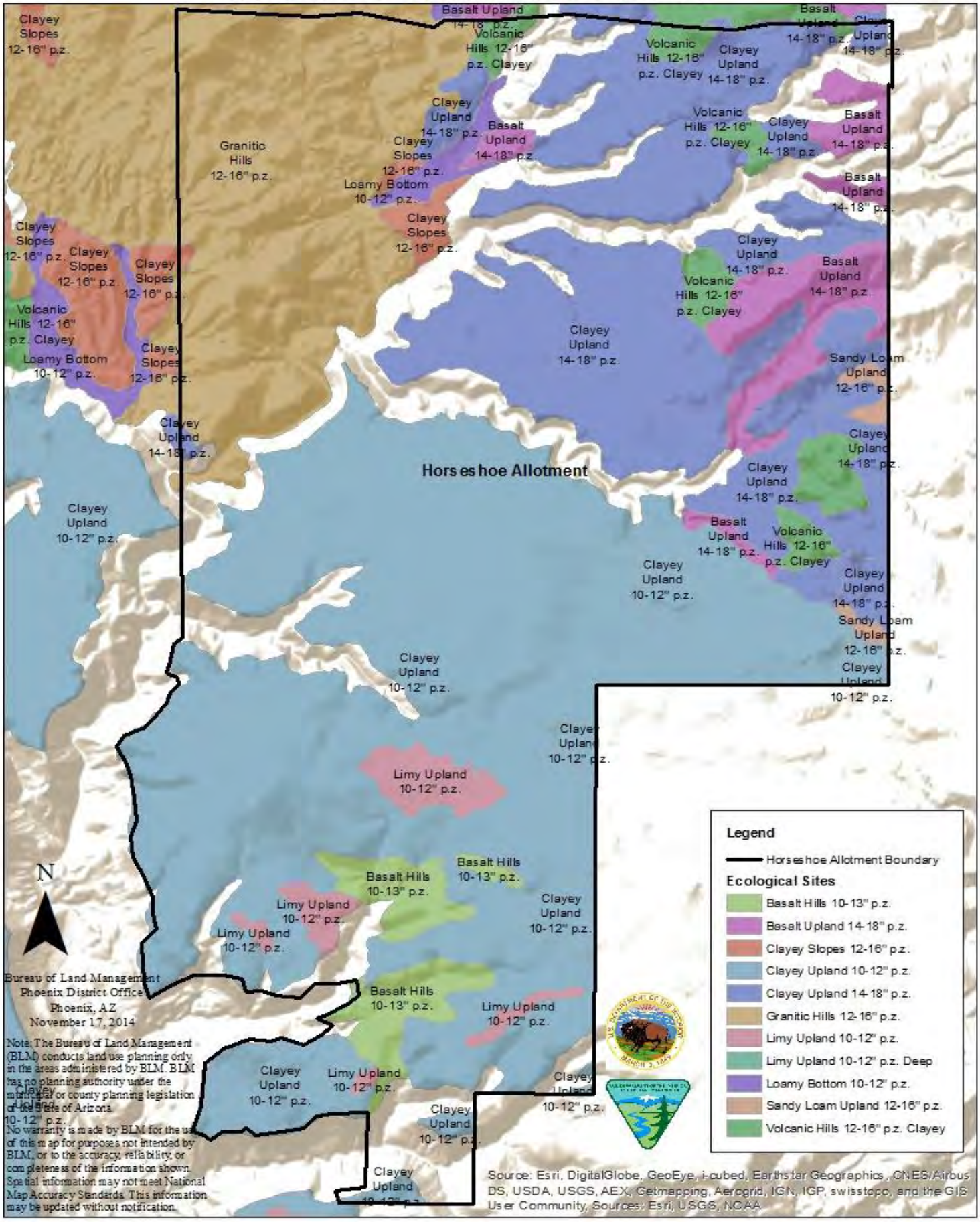
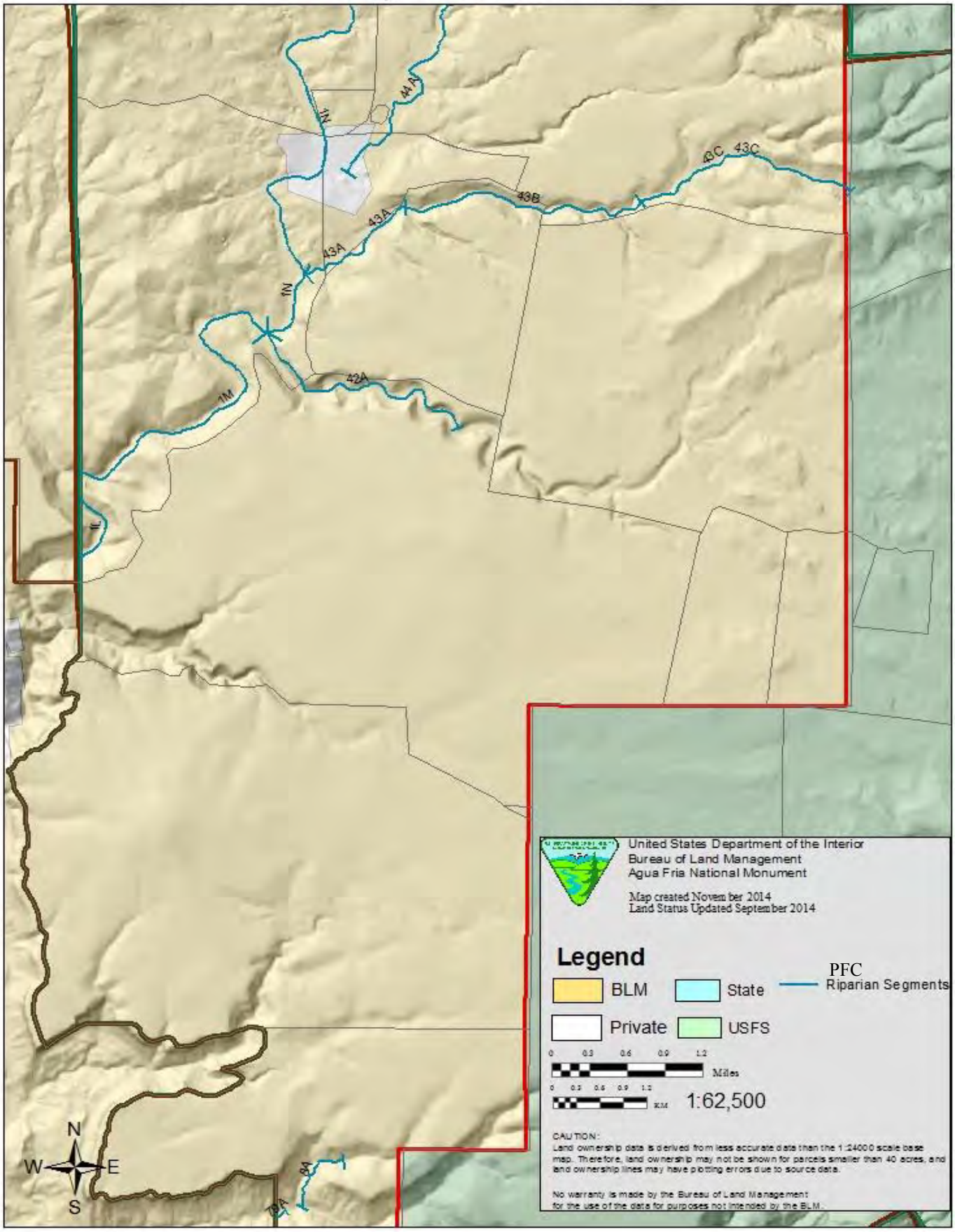
13.0 Maps


Map 1. Horseshoe Allotment with Pasture Locations
North River
Boone Tank
Indian
Bobcat
South River
Silver Creek
Double Tank
Horseshoe Allotment
New Mill
Copper
Copper
Joe's Hill
Perry
Brooklyn
Lousy
N
Bureau of Land Management
Phoenix District Office
Phoenix, AZ
November 17, 2014
Note: The Bureau of Land Management (BLM) conducts land use planning only in the areas administered by BLM. BLM has no planning authority under the municipal or county planning legislation of the State of Arizona.
No warranty is made by BLM for the use of this map for purposes not intended by BLM, or to the accuracy, reliability, or completeness of the information shown. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.
Source: Esri, DigitalGlobe, CNES/Airbus DS, USDA, swisstopo, and the GIS
Legend
BLM
Private
State
USFS
Horseshoe Allotment Boundary
Horseshoe Allotment Pastures

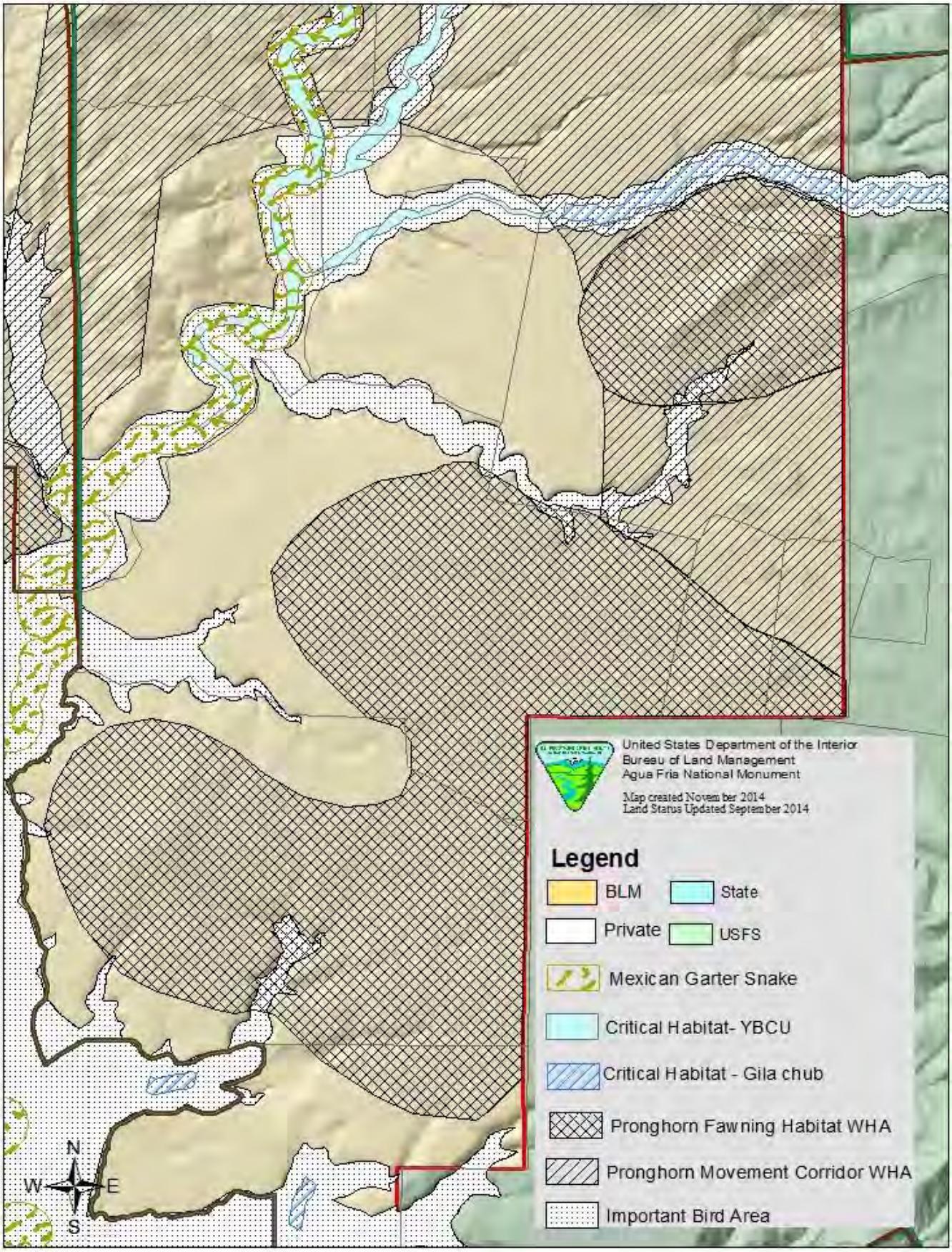
Map 2. Horseshoe Allotment Major Ecological Sites



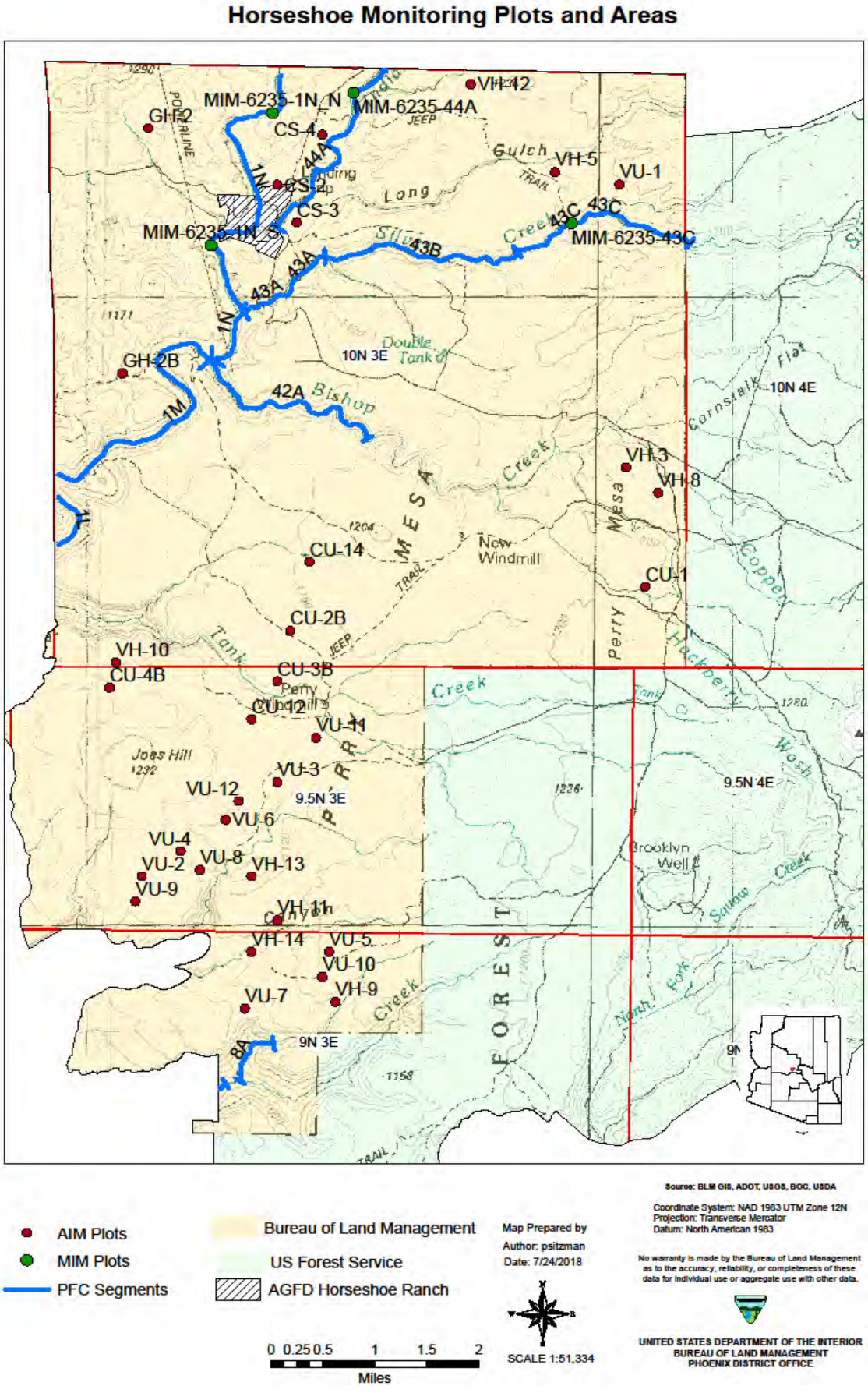
Map 3. Riparian Resources



Map 4. Wildlife Special Designation Areas



Map 5. AIM plots, MIM, and PFC segment locations.



Map 6. Horseshoe Allotment fire history map (2009-2018)