

**United States Department of the Interior
Bureau of Land Management
Sonoran Desert National Monument**

**Final Livestock Grazing
Compatibility Analysis**

**Sonoran Desert National Monument
Complex**

Arnold (#03004)
Beloat (#03007)
Big Horn (#03009)
Conley (#03018)
Hazen (#03042)
Lower Vekol (#03053)

July 2, 2020

Table of Contents

1.0	Introduction.....	1
2.0	Methods.....	2
2.1	Review Existing Literature.....	2
2.2	Review Existing Studies.....	3
2.3	Conduct Additional Studies	6
3.0	Discussion of Biological Object Indicators by Allotment	15
3.1	Arnold.....	15
3.2	Beloat	15
3.3	Big Horn.....	16
3.4	Conley	17
3.5	Hazen.....	18
3.6	Lower Vekol.....	18
3.7	Monument Wide.....	19
4.0	Archaeological and Historic Objects	21
4.1	Indicators to Evaluate the “Health” of Cultural Monument Objects.	21
4.2	Methodology/Monitoring to Assess “Indicators.”	21
4.3	Observed Impacts of Grazing on Cultural Monument Objects.....	21
5.0	Assess Compatibility of Livestock Grazing on SDNM	26
6.0	Literature Cited	27

Appendices

Appendix A – Sonoran Desert National Monument Proclamation

Appendix B – Pacific Biodiversity Report

Appendix C – Land Health Evaluation

Appendix D – Saguaro Cactus Forest Study

1.0 Introduction

The purpose of this draft compatibility analysis is to determine whether livestock grazing is compatible with the monument objects of the Sonoran Desert National Monument (SDNM) within monument portions of six grazing allotments north of Interstate 8 (I-8). The Presidential Proclamation establishing the SDNM (Appendix A) dictates that "...grazing on Federal lands north of I-8 shall be allowed to continue only to the extent that the Bureau of Land Management (BLM) determines that grazing is compatible with the paramount purpose of protecting the objects identified in this proclamation." Grazing on lands administered by the BLM are guided by several laws and regulations including the Taylor Grazing Act of 1934, Federal Land Policy and Management Act (FLPMA) of 1976, and the Public Rangeland Improvement Act of 1978. Under FLPMA 302(a), BLM must manage the land to implement the purpose of the Presidential Proclamation.

The monument objects of the SDNM as described in the Presidential Proclamation can be categorized as physical, biological, and cultural. The existence of the physical monument objects such as the Sand Tank Mountains and the broad alluvial valleys are merely the landscape on which livestock grazing occurs and is unlikely to be adversely impacted by livestock grazing. For this reason, the physical objects were not assessed. Livestock grazing is inherently intertwined with the ecosystems in which grazing occurs and therefore the biological monument objects are the focus of this analysis. There is potential for livestock to interact with cultural resources and those interactions are assessed in this document.

2.0 Methods

2.1 Review Existing Literature

A literature review was conducted to examine existing studies on livestock grazing impacts on Sonoran Desert ecosystems. The review examined numerous studies of livestock grazing in arid environments, but few studies were specific to the Sonoran Desert. However, several general observations became apparent:

1. Writers from all sides of the issue do not dispute the harmful effects of livestock grazing when ranges are overstocked. The conclusion that overgrazing arid rangelands substantially damages soils; alters the density, structure, and composition of desert vegetation types; and affects ecosystem function is not controversial (Waser & Price 1981; Bahre 1991; Balling et al. 1998; Hall et al. 2005; Holechek et al. 2005; Neff et al. 2005).
2. Rangelands in the desert southwest in general, and the Sonoran Desert in particular, are “marginal” ranges (Arizona Interagency Range Committee 1975; Hanrahan 1975). Average annual forage production of Sonoran Desert rangeland is lowest in comparison to all other range types of the western United States, save the Mojave Desert (Holechek & Hess 1996); however, annual forage, preferred by livestock, production is highly variable and heavily influenced by seasonal precipitation patterns (Waser and Price 1981; Holechek et al. 1999; Hall et al. 2005).
3. Climate has a profound influence on Sonoran Desert plant communities. Changes in plant species composition, density, and age structure may result from abnormally high seasonal precipitation or from periodic drought, obscuring or exacerbating impacts from human activities such as livestock grazing (Martin & Turner 1977; Robinett 1992; Turner 1990; Hall et al. 2005).
4. Due to the above three observations, livestock grazing in the Sonoran Desert must be carefully managed to prevent the damaging impacts of overstocking. Generally speaking, the percent utilization of annual forage production by livestock should be limited to 30-35 percent to prevent lasting damage to the forage resource, and to maximize livestock productivity and financial return (Holechek et al. 1999). Such a stocking rate is Classified as “light to moderate,” in contrast to “heavy” stocking levels that do not allow desirable forage species to maintain themselves, thus leading to reduced livestock productivity and financial return (Holechek et al. 2005).
5. There are few studies of impacts to cultural resources from livestock grazing. It is clear that artifacts such as pottery shards are most likely to be impacted, but it can be difficult to determine if adverse impacts have been caused by grazing or recreational activities such as camping or a combination of factors. A study by Osborn and Hartley in 1987 concluded that artifacts are most likely to be damaged if they are near areas of concentrated livestock use such as water locations. Brown and Stone, 1982, came to a similar conclusion when surveying the Central Arizona Project.

2.2 Review Existing Studies

Three studies are known to have been conducted on the SDNM that directly measure attributes of the biological monument objects. The BLM conducted a rangeland survey to assist with planning and decision making (BLM 1985), the Pacific Biodiversity Institute (PBI) conducted a survey of the natural plant communities and their conditions in relation to human stressors, and the BLM conducted a land health evaluation (LHE) for the SDNM north of I-8 to determine if livestock grazing is compatible with the SDNM's monument objects. These studies employed methods unique to their time and place, and provided results in regards to the overall land health of the SDNM and its surrounding areas.

Between 1979 and 1981, the BLM's Phoenix District completed a rangeland survey of the Lower Gila South Resource Management Plan (RMP)/Environmental Impact Statement (EIS) area which includes what is now the SDNM. The survey was conducted using BLM's rangeland inventory method for mapping and the Soil Conservation Service (SCS) method for determining condition and trend. BLM resource specialists used natural-color aerial photographs, topographic maps, soil survey information, and a helicopter to map preliminary range sites or complexes of range sites. SCS provided technical range site guides for the planning area, and the Arizona State Land Department inventoried state lands concurrently, using the range site concept. The rangeland condition of areas within a range site was determined by comparing the existing plant community to the climax plant community as shown by the technical guide for the site. The guides were based on the weight of species in the climax plant community to express ecological condition. The condition rating was determined by counting the percentage of each climax species as it relates to a near-climax condition. The rating ranges from 0 to 100, depending on how closely the plant community resembles the climax plant community for the range site. Apparent trend was also ascertained by assessing attributes of the plant community such as species composition, seedling and young plant abundance, plant residues, vigor, and soil surface cover.

The results of this study showed the majority, approximately 68 percent, of the grazing allotments that now make up the SDNM to be in "good" to "excellent" condition and have a "static" to "upward" trend (BLM 1985). Determinations for the causal factor for condition ratings and apparent trend were not ascertained.

In 2002, PBI, a subcontractor of The Nature Conservancy through an assistance agreement with the BLM, collected estimates of vegetative canopy and ground cover to assess the ecological condition of SDNM (Appendix B). This study was designed to map and assign condition Classes to the natural communities of the SDNM and was intended to be used as baseline information to assess trends and significant factors that may be influencing the condition of the natural communities within the SDNM. The study was conducted in two phases.

During phase 1, a vegetation community map was developed to show the distribution of the most common vegetation communities across the SDNM. This map was developed through the use of field surveys and the interpretation of aerial and satellite imagery. Field surveys consisted of a series of 30-meter (98 feet) radius plots where percent

cover of plant species and ground cover were collected as well as site specific information such as elevation, aspect, and slope. The field surveys were conducted outside of the growing seasons while the majority of the vegetation was senesced. Delineating vegetation community boundaries was apparently challenging.

In phase 2 the primary factors influencing variation in species composition for each major vegetation community was assessed. Geographic information systems (GIS) layers of “disturbances”, such as livestock congregation areas, roads, and linear disturbances were produced to be used in a model to map ecological condition. Exotic species monitoring was conducted where 3-meter (9.8 feet) radius plots were monitored along travel corridors at half-mile intervals. Additionally 320 “natural community condition assessment plots” were monitored. These consisted of 12.5-meter (41 feet) radius plots where canopy by species, ground cover Classes and “disturbance data” such as livestock prints, dung piles, trails, and off-highway vehicle (OHV) tracks were estimated. Line point intercept was attempted at these plots with a small number of points. This data was not used quantitatively but informed the estimates of each attribute. These plots were distributed along “disturbance-gradient transects” that extended out from selected disturbed areas at set intervals. Additional plots were strategically located in undisturbed areas to support the natural variation of the vegetation communities. Other monitoring methods were developed to inventory unique vegetation communities such as mesquite woodlands and desert grasslands.

A statistical analysis was conducted using this information where a hierarchical cluster analysis and DECORANA graphs were used to assign each community plot a condition Class 1 (highly disturbed and altered sites) to Class 3 (relatively undisturbed). Condition Class assignments were made primarily on the basis of professional judgment and were informed by the integration of the results from the analysis described above, field data, notes, and plot photos. The plots with assigned condition Classes were then mapped and extrapolated to the larger area by natural community. The natural community condition map was then overlaid with the mapped disturbance areas as described above to produce a model. Areas within 500 meters (1,640 feet) of livestock aggregation areas were mapped as Class 1. If it appeared to be disturbed in the aerial image it was mapped as disturbed/Class 1.

Additional analysis was conducted for each natural community. Communities were broken into groups based on species composition using hierarchical cluster analysis. Then, species diversity and cover, dependent variables, of the groups were compared against geographic variables and disturbance indices, explanatory variables, in an attempt to explain the variability of each group’s data. The livestock index is defined by the number of cow prints, horse prints, cow trails, and cow/horse dung piles observed on each site. Correlation between plots split into their disturbance categories were compared with environmental and disturbance gradients. Class 1 inherently correlated with distance from livestock congregation due to how Class 1 plots were defined. 53 percent of the Creosote-Bursage Desert Scrub community was Classified as Class 1 through the interpretation of the data. However, 76 percent of the community was ultimately Classified as Class 1 due to being located within 500 meters (1,640 feet) of livestock water locations. The results of this study showed the Creosote-Bursage Desert

Scrub community to be impaired by human-related stress factors and most correlated to distance from potential livestock congregation areas.

The Palo Verde – Mixed Cacti – Mixed Scrub on Bajadas community is less impaired by human-related stress factors compared to creosote. Ecological condition appeared to be most correlated to distance from potential livestock congregation areas. The Palo Verde – Mixed Cacti – Mixed Scrub on Rocky Slopes was not impaired by human-related stress factors. The Xeroriparian Scrub community was most influenced by elevation. However, some evidence of human-related stress factors were explained to be caused by OHV use rather than livestock. The Braided Channel Floodplains community did correlate with livestock activity index, but only a weak correlation with distance from potential livestock congregation areas. This information was then used to determine the ecological condition of the major vegetation communities where proportions of each community were assigned condition Class ratings of 1, 2, or 3. The study determined that the overall ecological condition of the SDNM is “moderately good.” However, the variability of the communities’ condition was considerable because of “human-related stress.”

In 2012, the BLM published the first LHE for the SDNM. The purpose of the LHE was to determine the condition of ecological sites and vegetation communities and to determine whether livestock grazing is compatible with the monument objects for which the SDNM was designated. Between 2002 and 2009, the BLM established and monitored 47 key areas. Key area monitoring consisted primarily of pace frequency, point cover, and dry weight rank. Data collected at each key area was compared to site specific desired plant community (DPC) objectives which were developed with the consideration of the SDNM’s monument objects. Generally, ranges of values defined in Natural Resources Conservation Service (NRCS) ecological site descriptions (ESDs) are used to inform site specific DPC objectives. However, the SDNM spans a transition zone between two major land resource areas (MLRAs) as defined by average annual precipitation and elevation. The ESDs describing the most prominent ecological sites on the SDNM, between the two MLRAs, are considered “provisional” by the NRCS, meaning the information within “represents the lowest tier of documentation that is releasable to the public” but contains enough information to distinguish between different ecological sites and have undergone quality control and quality assurance protocols. In lieu of these factors, the BLM determined the ESDs required supplemental data to adequately develop the DPC objectives for the 2012 LHE.

The BLM supplemented the information in the ESDs with data from ungrazed reference areas on the Barry M. Goldwater Air Force Range/Area A (BMGR/Area A), south of I-8. The BLM and PBI collected data from BMGR/Area A on key areas that represented ecological sites also present on the SDNM north of I-8. However, the ecological sites north of I-8 receive, on average, less annual precipitation than ecological sites south of I-8. Data collected from the key areas south of I-8 were averaged, by ecological site, and used to develop DPC objectives with the consideration of less annual precipitation on sites north of I-8. The reductions of DPC objectives between ecological site types varied because of site specific potentials. The BLM also used PBI monitoring plots that fit the key area concept and compared them to the same DPC objectives, but were unable to determine if grazing was the causal factor for non-achievement of DPC objectives

because utilization data was not collected by PBI. Despite the amount of data collected between 2002 and 2009, the BLM was only able to use one year of data at each monitoring plot because plots either lacked more than one year worth of data or had monitoring protocol inconsistencies between years. Peer reviewers of the 2012 LHE indicated that multiple years of vegetation and utilization data are ideal and would result in a stronger analysis and determination of livestock grazing as the causal factor for non-achievement of DPC objectives.

Between 2012 and 2014 the BLM collected additional key area monitoring data on the allotments that make up the SDNM. This data was used to inform the Maricopa Mountains Allotment Complex LHE (2014) which was used to address the SDNM allotments at a broader scale, inside and outside the SDNM. However, this LHE relied on similar methods as the 2012 LHE including incomplete ESDs and contained monitoring inconsistencies which made it infeasible to set defensible DPC objectives and ascertain trend. For these reasons the 2014 LHE was not used to inform management decisions on the allotments that make up the SDNM.

In 2016, the U.S. District Court, District of Arizona found that BLM did not adequately explain the process that led to the 2012 LHE and the compatibility determination used to inform the 2012 Record of Decision and Final RMP/EIS. The BLM was ordered to complete a new LHE to update the decisions pertaining to livestock grazing in the 2012 ROD and Final RMP/EIS.

2.3 Conduct Additional Studies

It was determined that additional studies were required to adequately assess livestock grazing on monument objects because of differing and unrepeatable monitoring techniques conducted in the past. The monument objects of the SDNM are described in Table 1.

Table 1: Biological and Cultural Objects of the Sonoran Desert National Monument

Monument Object	Element	Indicator
Functioning Desert Ecosystem	Saguaro Cactus (<i>Carnegiea gigantea</i>) Forest (see Saguaro Cactus Forest object below) Habitat for a wide range of wildlife species (see wildlife object below)	Standards for Rangeland Health
Diversity of Plant and Animal Species	Woodland assemblages, Palo Verde-Mixed Cacti Vegetation Community, Tinajas	Standards for Rangeland Health
Saguaro Cactus Forest	Saguaro cactus and nurse plants	Standards for Rangeland Health and Recruitment
Scientific Analysis of Plant Species and Climates in Past Eras	Packrat middens, Kofa Mountain barberry (<i>Berberis harrisonianai</i>), Juniper (<i>Juniperus spp.</i>), Arizona Rosewood (<i>Vauquelinia californica</i>)	Presence and protection
Vegetation Communities: Creosote-Bursage, Desert Grassland, and Washes	Creosote-Bursage Vegetation Community, Washes	Standards for Rangeland Health

Monument Object	Element	Indicator
Wildlife	Sonoran Desert Tortoise (<i>Gopherus morafkai</i>), Desert Bighorn Sheep (<i>Ovis canadensis mexicana</i>), Raptors, Owls (including Elf Owl (<i>Micrathene whitneyi</i>), Cactus Ferruginous Pygmy Owl (<i>Glaucidium brasilianum cactorum</i>) and Western Screech Owl (<i>Megascops kennicottii</i>), Mule Deer (<i>Odocoileus hemionus</i>), Javelina (<i>Pecari tajacu</i>), Lesser Long-Nosed Bat (<i>Leptonycteris yerbabuena</i>) (see above), California Leaf-Nosed Bat (<i>Macrotus californicus</i>), Cave Myotis Bat (<i>Myotis velifer</i>)	Standards for Rangeland Health
Archaeological and Historic Sites	Rock Art Sites, Lithic Quarries, Scattered Artifacts, Vekol Wash, Juan Batista de Anza National Historic Trail, Mormon Battalion Trail, Butterfield Overland Stage Route	Presence and protection

Many of the attributes of the biological monument objects are related to BLM Standards for Rangeland Health (Standards) (Table 1). The Committee on Rangeland Classification, Board of Agriculture, National Research Council defined Rangeland Health "...as the degree to which the integrity of the soil and ecological processes of rangeland ecosystems are sustained" (National Research Council 1994). Standards describe conditions necessary to encourage proper functioning of ecological processes on specific ecological sites. These Standards are measurable and attainable goals for the desired condition of the biological resources and physical components/characteristics of desert ecosystems found within the SDNM. When Standards are achieved on plots that represent specific monument objects, the health of those objects are assured. For example, if the Standards are being achieved within the vegetation communities of the SDNM, livestock grazing would be compatible with the monument objects those vegetation communities represent (functioning desert ecosystem, diversity of plant species, saguaro nurse plant, creosote-bursage, palo verde-mixed cactus, and wash communities, and wildlife habitat).

The following analysis incorporates data applicable to the SDNM from the new LHE for the SDNM Complex (Appendix C), where the study area is described in detail, and the Standards are assessed for the portions of each allotment on and off the SDNM. The evaluation ascertains: 1) if standards are being achieved or not achieved; and 2) where it is ascertained that Standards are not being achieved, determine whether livestock grazing is the significant causal factor for non-achievement.

For the purpose of this grazing compatibility analysis, historical grazing is any grazing that occurred two years prior to data collection. The most recent grazing permits issued show the number of perennially authorized AUMs on the SDNM portion of grazing allotment permits under the Lower Gila South RMP prior to the completion of the Lower Sonoran and SDNM RMP of 2012. The maximum number of historically authorized AUMs was 8,703, SDNM wide, see Table 2 for break down by allotment. Current grazing use, hereafter referred to as "livestock grazing", is considered to be any grazing that occurred on allotments within two years of data collection, including unauthorized use. Due to the lack of recent use on the majority of the SDNM, use

probability and other factors were assessed to determine potential impacts of livestock grazing.

Table 2. Authorized perennial animal unit months (AUMs) on the SDNM portion of the SDNM Complex Allotments pre 2012 RMP.

Allotment	AUMs
Arnold	0
Beloat	776
Big Horn	2,812
Conley	3,403
Hazen	886
Lower Vekol	826
Total	8,703

Results in this Compatibility Analysis differ from the LHE because only the monitoring plots within the SDNM were used to determine ecological site achievement/non-achievement of Standards and the percentages of vegetation communities (monument objects) achieving/not achieving Standards.

It was determined that the LHE could not adequately represent the density and recruitment of the saguaro cactus forest. An additional study was conducted to: 1) define a saguaro forest; 2) map the saguaro forest; and 3) assess potential livestock impacts to the saguaro forest (Appendix D). This study can be referenced when reviewing the results of the saguaro cactus forest object in the Table 3 and the discussion in section 3.0.

Table 3. Results for Plots and Vegetation Communities within the SDNM (Biological/Ecological Objects)

Biological Indicator	Applicable Standards	Evaluation Results (if applicable)
Monument Object: Functioning Desert Ecosystem		
See Monument Object: Saguaro Cactus Forest		
See Monument Object: Vegetation Communities		
Habitat for a wide range of wildlife species (See Monument Object: Wildlife)		
Monument Object: Diversity of Plant and Animal Species		
Palo Verde-Mixed Cacti Vegetation Community	Land Health Standard 1: Assessments of Soil/Site Stability, Hydrologic Function, and Biotic Integrity on plots that represent the Palo Verde-Mixed Cacti Vegetation Community	Arnold <ul style="list-style-type: none"> • 53 acres of Palo Verde-Mixed Cactus are within the SDNM portion of the Arnold • 0% is failing to achieve Standard 1 • 0% is failing to achieve Standard 3 Beloat <ul style="list-style-type: none"> • 5,195 acres of Palo Verde-Mixed Cactus are within the SDNM portion of the Beloat • 0% is failing to achieve Standard 1 • 40% is failing to achieve Standard 3 but 0% is due to livestock grazing
	Land Health Standard 3: Desired Plant Community Objectives for plots that represent the Palo Verde-Mixed Cacti Vegetation Community - Provide soil cover, forage for wildlife, and	

Biological Indicator	Applicable Standards	Evaluation Results (<i>if applicable</i>)
	species diversity appropriate for each ecological site.	<p>Big Horn</p> <ul style="list-style-type: none"> • 28,681 acres of Palo Verde-Mixed Cactus are within the SDNM portion of the Big Horn • 0% is failing to achieve Standard 1 • 20% is failing to achieve Standard 3 but 0% is due to livestock grazing <p>Conley</p> <ul style="list-style-type: none"> • 18,819 acres of Palo Verde-Mixed Cactus are within the SDNM portion of the Conley • 22.2% is failing to achieve Standard 1 and 22% is failing due to livestock grazing • 22.2% is failing to achieve Standard 3 but 0% is due to livestock grazing <p>Hazen</p> <ul style="list-style-type: none"> • 6,405 acres of Palo Verde-Mixed Cactus are within the SDNM portion of the Hazen • 0% is failing to achieve Standard 1 • 0% is failing to achieve Standard 3 <p>Lower Vekol</p> <ul style="list-style-type: none"> • 5,743 acres of Palo Verde-Mixed Cactus are within the SDNM portion of the Lower Vekol • 20% is failing to achieve Standard 1 and 20 % is failing due to historical livestock grazing • 40% is failing to achieve Standard 3 and 40% is failing due to historical livestock grazing
Monument Object: Saguaro Cactus Forests		
Saguaro cactus forest and nurse plants	<p>Saguaro Forest: Acres and percentage within 2 miles of livestock waters.</p> <p>Land Health Standard 1: Granitic Upland, Limy Upland, Limy Upland Deep, Sandy Bottom, Sandy Loam Deep, and Sandy Loam Upland ecological sites - provide suitable soil and hydrologic conditions for saguaros and nurse plants.</p> <p>Land Health Standard 3: Granitic Upland, Limy Upland, Limy Upland Deep, Sandy Bottom, Sandy Loam Deep, and Sandy Loam</p>	<p>Arnold</p> <ul style="list-style-type: none"> • There are no saguaro forests within the Arnold Allotment <p>Beloat:</p> <ul style="list-style-type: none"> • 272 acres of saguaro forest are within the Beloat and 10% is within 2 miles of livestock waters • Achieves Standard 1 for Granitic Upland, Limy Upland, Limy Upland Deep, and Sandy Bottom ecological sites • Achieves Standard 3 for the Granitic Upland, Limy Upland, and Sandy Bottom ecological sites • Fails to achieve Standard 3 for the Limy Upland Deep ecological site and livestock grazing is not the causal factor

Biological Indicator	Applicable Standards	Evaluation Results (<i>if applicable</i>)
	Upland ecological sites - provide vegetative cover of nurse plants.	<p>Big Horn:</p> <ul style="list-style-type: none"> • 3,427 acres of saguaro forest are within the Big Horn and 11% is within 2 miles of livestock waters • Achieves Standard 1 on the Limy Upland, Limy Upland Deep, and Sandy Bottom ecological sites • Achieves Standard 3 for the Limy Upland, Limy Upland Deep, and Sandy Bottom ecological sites <p>Conley:</p> <ul style="list-style-type: none"> • 4,518 acres of saguaro forest are within the Conley and 20% is within 2 miles of livestock waters • Achieves Standard 1 on Limy Upland, Sandy Loam Upland, and Sandy Bottom ecological sites • Fails to achieve Standard 1 on the Sandy Loam Deep ecological site and livestock grazing is the causal factor • Achieves Standard 3 for the Limy Upland, Limy Upland Deep, Sandy Bottom, Sandy Loam Deep, and Sandy Loam Upland ecological sites. <p>Hazen:</p> <ul style="list-style-type: none"> • 73 acres of saguaro forest are within the Hazen and 42% is within 2 miles of livestock waters • Achieves Standard 1 on Granitic Upland, Limy Upland, Limy Upland Deep, and Sandy Bottom ecological sites • Achieves Standard 3 on Granitic Upland, Limy Upland, Limy Upland Deep, and Sandy Bottom ecological sites <p>Lower Vekol:</p> <ul style="list-style-type: none"> • 643 acres of saguaro forest are within the Lower Vekol and 0% is within 2 miles of livestock waters • Achieves Standard 1 on Limy Upland, Sandy Bottom, and Sandy Loam Deep ecological sites • Fails to achieve Standard 1 on the Limy Upland Deep ecological site and historical livestock grazing is the causal factor • Achieves Standard 3 on the Limy Upland Deep and Sandy Loam Deep ecological sites • Fails to achieve Standard 3 on Limy Upland ecological site and historical livestock grazing is the causal factor

Biological Indicator	Applicable Standards	Evaluation Results <i>(if applicable)</i>
		<ul style="list-style-type: none"> • Fails to achieve Standard 3 on Sandy Bottom ecological site and livestock grazing is not the causal factor
<i>Monument Object: Scientific Analysis of Plant Species and Climates in Past Eras</i>		
Packrat middens	Ancient middens occur in dry caves and rock shelters where they are protected from moisture. Livestock do not generally utilize areas with dry caves and rock shelters due to steep, rocky and rough terrain.	
Kofa Mountain barberry, Juniper, Arizona Rosewood	These species only occur at high elevations within the SDNM. These areas are inaccessible to livestock due to steep, rocky and rough terrain.	

Monument Object: Vegetation Communities: Creosote-Bursage, Desert Grassland, and Washes		
<p>Creosote-Bursage Vegetation Community</p>	<p>Land Health Standard 1: Assessments of Soil/Site Stability, Hydrologic Function, and Biotic Integrity for ecological sites representing the Creosote-Bursage Vegetation Community</p> <p>Land Health Standard 3: DPC objectives for ecological sites representing Creosote-Bursage Vegetation Community- Provide soil cover, forage for wildlife, and species diversity appropriate for each ecological site.</p>	<p>Arnold</p> <ul style="list-style-type: none"> • 1,095 acres of Creosote-Bursage are within the SDNM portion of the Arnold • 12.5% of Creosote-Bursage on the Arnold is failing to achieve Standard 1 and 12.5% is failing due to livestock grazing • 62.5% of Creosote-Bursage on the Arnold is failing to achieve Standard 3 and 25% is due to livestock grazing <p>Beloat</p> <ul style="list-style-type: none"> • 23,513 acres of Creosote-Bursage are within the SDNM portion of the Beloat. • 16.7% is failing to achieve Standard 1 and 16.7% is failing due to historical livestock grazing • 0% is failing to achieve Standard 3 <p>Big Horn</p> <ul style="list-style-type: none"> • 44,335 acres of Creosote-Bursage are within the SDNM portion of the Big Horn. • 37.5% is failing Standard 1 and 37.5% is failing due to historical livestock grazing • 25% is failing to achieve Standard 3 and 12.5% is due to historical livestock grazing <p>Conley</p> <ul style="list-style-type: none"> • 43,304 acres of Creosote-Bursage are within the SDNM portion of the Conley • 60% is failing to achieve Standard 1 and 40% is failing due to livestock grazing • 60% is failing to achieve Standard 3 and 20% is due to livestock grazing <p>Hazen</p> <ul style="list-style-type: none"> • 16,265 acres of Creosote-Bursage are within the SDNM portion of the Hazen • 0% is failing to achieve Standard 1 • 20% is failing to achieve Standard 3 but 0% is due to livestock grazing <p>Lower Vekol</p> <ul style="list-style-type: none"> • 5,236 acres of Creosote-Bursage are within the SDNM portion of the Hazen • 0% is failing to achieve Standard 1 • 33.3% is failing to achieve Standard 3 and 33.3% is failing due to historical livestock grazing

<p>Washes</p>	<p>Land Health Standard 1: Assessments of Soil/Site Stability, Hydrologic Function, and Biotic Integrity on Sandy Bottom Ecological Site</p> <p>Land Health Standard 3: DPC objectives for the Sandy Bottom Ecological Site</p>	<p>Arnold</p> <ul style="list-style-type: none"> • 0 miles of washes are within the SDNM portion of the Arnold <p>Beloat</p> <ul style="list-style-type: none"> • 184.7 miles of washes are within the SDNM portion of the Beloat • 0% is failing to achieve Standard 1 • 25% is failing to achieve Standard 3 and 25% is due to livestock grazing <p>Big Horn</p> <ul style="list-style-type: none"> • 183.6 miles of washes are within the SDNM portion of the Big Horn • 0% is failing to achieve Standard 1 • 0% is failing to achieve Standard 3 <p>Conley</p> <ul style="list-style-type: none"> • 167.4 miles of washes are within the SDNM portion of the Conley • 25% is failing to achieve Standard 1 and 25% is due to livestock grazing • 0% is failing to achieve Standard 3 <p>Hazen</p> <ul style="list-style-type: none"> • 76.9 miles of washes are within the SDNM portion of the Hazen • 0% is failing to achieve Standard 1 • 40% is failing to achieve Standard 3 but 0% is due to livestock grazing <p>Lower Vekol</p> <ul style="list-style-type: none"> • 34.7 miles of washes are within the SDNM portion of the Lower Vekol • 0% is failing to achieve Standard 1 • 25% is failing to achieve Standard 3 but 0% is due to livestock grazing
---------------	---	---

Monument Object: Wildlife*	
<p>Sonoran Desert Tortoise</p> <p>Desert Bighorn Sheep</p> <p>Mule Deer</p>	<p>Land Health Standard 1: Soil Site Stability, Hydrologic Function, and Biotic Integrity for the Granitic Upland, Limy Upland, Sandy Bottom ecological sites</p> <p>Land Health Standard 3: DPC objectives for the Granitic Upland, Limy Upland, Sandy Bottom ecological sites</p>
	<p>Arnold</p> <ul style="list-style-type: none"> • Achieves Standard 1 and 3 for Granitic Upland ecological site <p>Beloat:</p> <ul style="list-style-type: none"> • Achieves Standard 1 for Granitic Upland, Limy Upland, and Sandy Bottom ecological sites • Achieves Standard 3 for the Granitic Upland, Limy Upland, and Sandy Bottom ecological sites <p>Big Horn:</p> <ul style="list-style-type: none"> • Achieves Standard 1 on the Limy Upland and Sandy Bottom ecological sites • Achieves Standard 3 for the Limy Upland and Sandy Bottom ecological sites <p>Conley:</p> <ul style="list-style-type: none"> • Achieves Standard 1 on Limy Upland and Sandy Bottom ecological sites • Achieves Standard 3 for the Limy Upland and Sandy Bottom ecological sites. <p>Hazen:</p> <ul style="list-style-type: none"> • Achieves Standard 1 on Granitic Upland, Limy Upland, and Sandy Bottom ecological sites • Achieves Standard 3 on Granitic Upland, Limy Upland, and Sandy Bottom ecological sites <p>Lower Vekol:</p> <ul style="list-style-type: none"> • Achieves Standard 1 on Limy Upland and Sandy Bottom ecological sites • Fails to achieve Standard 3 on Limy Upland ecological site and historical livestock grazing is the causal factor • Fails to achieve Standard 3 on Sandy Bottom ecological site and livestock grazing is not the causal factor
Lesser Long-Nosed Bat (see above)	Evaluation of saguaro cactus forests conditions and applicable ecological sites evaluates habitat needs within SDNM, north of I-8, for this species.
California Leaf-Nosed Bat	Evaluation of all vegetative communities addresses suitable forage habitat. No known roost sites on SDNM (Hinman and Snow, eds.). Forage (insects) area could occur in monument.
Cave Myotis Bat	Evaluation of all vegetative communities addresses suitable forage habitat. No known roost sites on SDNM (Hinman and Snow, eds.). Forage (insects) area could occur in monument.

*There are no plots representing the Creosote-Bursage Vegetation Community within the SDNM portion of the Arnold Allotment. Percentages achieving/not achieving Standards were extrapolated from plots within the vegetation community outside of the SDNM.

3.0 Discussion of Biological Object Indicators by Allotment

3.1 Arnold

There is one Granitic Upland plot representing the Palo Verde-Mixed Cactus Vegetation Community located within the SDNM portion of the Arnold Allotment and it is achieving both Standard 1 and 3. There are no plots representing the Creosote-Bursage Vegetation Community within the SDNM portion of the Arnold. However, livestock grazing was determined to be the causal factor for the non-achievement of Standard 1 on 12.5 percent and Standard 3 on 25 percent of the Creosote-Bursage community on the Arnold outside of the SDNM. There are no saguaro forests within the Arnold. The Arnold comprises only a minor component, 1 percent, of the SDNM. Much of the SDNM portion, 45 percent, of the Arnold is fenced to exclude livestock grazing. The unfenced areas of the SDNM portion of the Arnold are 1.9 miles from the nearest livestock water location and in livestock use probability Classes 4 and 5 which are unlikely to receive livestock use when ephemeral grazing is authorized.

Based on the field observations and monitoring data, it is unlikely that current or historical livestock grazing is impacting the SDNM's biological objects within the Arnold Allotment.

3.2 Beloat

The Beloat Allotment has 11 random plots located within the SDNM representing Granitic Upland, Limy Fan, Limy Upland, Limy Upland Deep, and Sandy Bottom ecological sites and the three most common vegetation communities. The majority of the ecological sites are achieving Standard 1 and 3 with the exception of the Limy Upland Deep ecological site that is failing to achieve the foliar cover and palatable species objectives of Standard 3. All Limy Upland Deep plots are located in livestock use probability Class 5 and no livestock sign was observed at these plots. Livestock grazing was determined not to be the causal factor for the non-achievement of Standard 3 on the Limy Upland Deep ecological site. The Limy Upland Deep plots within the Beloat are primarily located on bajadas which receive limited run-on moisture.

The majority of the plots representing the Limy Fan and Granitic Upland ecological sites achieve Standards 1 and 3 with the exception of one Limy Fan plot that failed to achieve Standard 1 and one Granitic Upland plot that failed to achieve Standard 3. Historical livestock grazing was determined to be the causal factor for the Limy Fan plot's non-achievement of Standard 1 but not for the Granitic Upland plot's non-achievement of Standard 3.

Of the vegetation communities the plots represent, historical livestock grazing is determined to not be the causal factor for the non-achievement of Standard 1 and 3 on the Palo Verde-Mixed Cacti Vegetation Community but is determined to be the causal factor for the non-achievement of Standard 1 on 16.7 percent of the Creosote-Bursage Vegetation Community and Standard 3 on 25 percent of the Wash Community.

Approximately 272 acres of saguaro forest are present in the SDNM portion of the Beloat of which 10 percent is within two miles of livestock water locations. Overall, the

majority, 57 percent, of the SDNM portion of the Beloat is within livestock use probability Class 5 where limited livestock grazing is expected to occur.

Three livestock waters are within the SDNM portion of the Beloat. The Limy Fan plot failing to achieve Standard 1 is located near the most reliable fenced reservoir, Tucker Tank. Livestock grazing has not occurred at this location in more than three years, however, significant historical livestock sign was observed and determined to be the causal factor for the non-achievement of the Soil Site Stability and Hydrologic Function objectives of Standard 1.

Due to the finding of the saguaro forest study and the Limy Fan plot failing to achieve Standard 1, due to historical livestock grazing, it is possible that historical livestock grazing may have impacted the saguaro cactus forest, diversity of plant and animal species, vegetation communities, and wildlife monument objects within close proximity to livestock waters but is unlikely to have impacted biological objects far, greater than 2 miles, from livestock waters.

3.3 Big Horn

The Big Horn Allotment has 17 random plots located within the SDNM representing Limy Fan, Limy Upland, Limy Upland Deep, and Sandy Bottom ecological sites. The majority of the ecological sites are achieving Standard 1 and 3 with the exception of the Limy Fan ecological site that is failing the Soil Site Stability, Hydrologic Function, and Biotic Integrity objectives of Standard 1. Current and historical livestock grazing was determined to be the causal factor for non-achievement of Standard 1 on the Limy Fan ecological site.

Of the vegetation communities the plots represent, livestock grazing was determined to be the causal factor for non-achievement of Standard 1 on 37.5 percent and Standard 3 on 12.5 percent of the Creosote-Bursage Vegetation Community but was not the causal factor for any non-achievement of Standards on the Palo Verde-Mixed Cacti and Wash Vegetation Communities.

Approximately 3,427 acres of saguaro forest is present in the SDNM portion of the Big Horn Allotment, of which, 11 percent is within two miles of livestock water. Overall, the majority, 74 percent, of the SDNM portion of the Big Horn is within livestock use probability Class 5 where limited to no livestock grazing is expected to occur.

The majority of the current livestock sign in the north pasture appears to be stemming from the unfenced State land where livestock are currently authorized to graze, by the Arizona State Land Department, perennially. It is likely that the current livestock sign observed at one Limy Fan plot failing to achieve Standard 1 and 3 and one Limy Upland failing Standard 1 in the north pasture is due to livestock drifting onto BLM lands from the Headquarters well located on unfenced State land.

One plot representing the Limy Fan ecological site in the south pasture failing Standard 1 with significant historical livestock sign observed is located near the Nija Reservoirs. It is likely that historical livestock grazing in this portion of the south pasture is the causal factor for non-achievement of Standard 1 on this plot.

Based on the field observations and monitoring data, it is unlikely that current or historical perennial livestock grazing is impacting the saguaro cactus forests in the north pasture; it is likely that current perennial livestock grazing is impacting the diversity of plant and animal species, vegetation communities, and wildlife near the State headquarters in the north pasture; and it is likely that historical livestock grazing has impacted the diversity of plant and animal species, saguaro cactus forest, vegetation communities, and wildlife objects near, less than two miles, livestock waters in the south pasture.

The two random monitoring plots within the Big Horn Pasture are achieving both Standard 1 and 3. Approximately 50 percent of the saguaro forest within two miles of livestock waters is in the Big Horn pasture, which has not had operable waters in more than ten years, but shows signs of historical livestock trailing stemming from Big Horn Well. Based on field observations and monitoring data, this pasture appears to be stable and achieving Standards 1 and 3 despite historical use.

3.4 Conley

The Conley Allotment has 17 random plots located within the SDNM representing Limy Fan, Limy Upland, Limy Upland Deep, Sandy Bottom, Sandy Loam Deep, and Sandy Loam Upland ecological sites. The majority of the ecological sites are achieving Standard 1 and 3 with the exception of the Limy Fan and Sandy Loam Deep ecological sites. The Limy Fan ecological site is failing to achieve both Standard 1 and 3 where Soil Site Stability and Hydrologic Integrity objectives are not achieved for Standard 1 and bare ground and palatable species objectives are not achieved for Standard 3. Livestock grazing was determined to be the causal factor for non-achievement of Standard 1 and 3 on the Limy Fan ecological site. The Sandy Loam Deep ecological site is failing to achieve all three objectives of Standard 1 and livestock grazing was determined to be the causal factor.

Of the vegetation communities the plots represent, livestock grazing was determined to be the causal factor for the non-achievement of Standard 1 on 40 percent and Standard 3 on 20 percent of the Creosote-Bursage Vegetation Community. Livestock grazing is also determined to be the causal factor for the non-achievement of Standard 1 on 22.2 percent of the Palo Verde-Mixed Cacti Vegetation Community and Standard 1 on 25 percent of the Wash Vegetation Community.

Approximately 4,518 acres of saguaro forest are within the SDNM portion of the Conley Allotment, of which, 20 percent are within two miles of livestock water. Livestock water is well distributed throughout the Conley where 45 percent of the allotment is within livestock use probability Class 5, low potential for use.

Current (less than two years), and historical livestock sign was observed in both the north and south pastures of the SDNM. The north pasture encompasses large alluvial plains and is more ephemeral in nature, vegetation communities comprised of < 5 percent desirable palatable species, than the more productive and diverse south pasture. Current perennial livestock grazing was determined to be the causal factor for failing Standards 1 and 3 on plots in both pastures.

Based on field observations and monitoring data; it is likely that current and historical perennial livestock grazing is impacting the saguaro forest and the overall diversity of plant and animal species, vegetation communities, and wildlife monument objects on the Conley.

3.5 Hazen

The Hazen Allotment has 17 random plots located within the SDNM representing Granitic Upland, Limy Fan, Limy upland, Limy Upland Deep and Sandy Bottom ecological sites. These ecological sites and the three most common vegetation communities are achieving Standard 1 and 3 on the Hazen. Approximately 73 acres of saguaro forest are present in the SDNM portion of the Hazen of which, 42 percent is within two miles of potential livestock waters. Due to the lack of use over the past eight years, 100 percent of the Hazen within the SDNM is in livestock use probability Class 5. This would change if livestock waters were returned to operating conditions.

Based on field observations and monitoring data, it is unlikely that current or historical livestock grazing are impacting biological monument objects.

3.6 Lower Vekol

The Lower Vekol Allotment has 10 random plots located within the SDNM representing Limy Upland, Limy Upland Deep, Sandy Bottom, and Sandy Loam Deep ecological sites. The majority of ecological sites are achieving Standard 1 with the exception of the Limy Upland Deep where all three objectives are not achieved. Standard 3 is achieved on the Limy Upland Deep and Sandy Loam Deep ecological sites. Bare ground objectives are not achieved on the majority of the Limy Upland plots. Bare ground and species diversity objectives are not achieved on one of the two Sandy Bottom plots. Of the vegetation communities the plots represent, historical livestock grazing was determined to be the causal factor for the non-achievement of Standard 1 and 3 on 33.3 percent of the Creosote-Bursage Vegetation Community, Standard 1 on 20 percent and Standard 3 on 40 percent of the Palo Verde-Mixed Cacti Vegetation Community, and Standard 1 and 3 on 0 percent of the Wash Vegetation Community.

Approximately 643 acres of saguaro forest are within the SDNM portion of the Lower Vekol, of which, 0 percent is within two miles of livestock waters. Livestock waters are primarily located in the eastern portions of the Lower Vekol, however, 49 percent of the allotment within the SDNM is in livestock use probability Class 5.

Significant historical livestock sign was observed on the Limy Upland and Limy Upland Deep ecological sites failing to achieve Standards in both the Poverty Flat and South Pastures. Within the SDNM, the livestock water service areas are ephemeral in nature. Significant historical livestock use appears to stem from the Little Bruce Reservoir and Jones Tank.

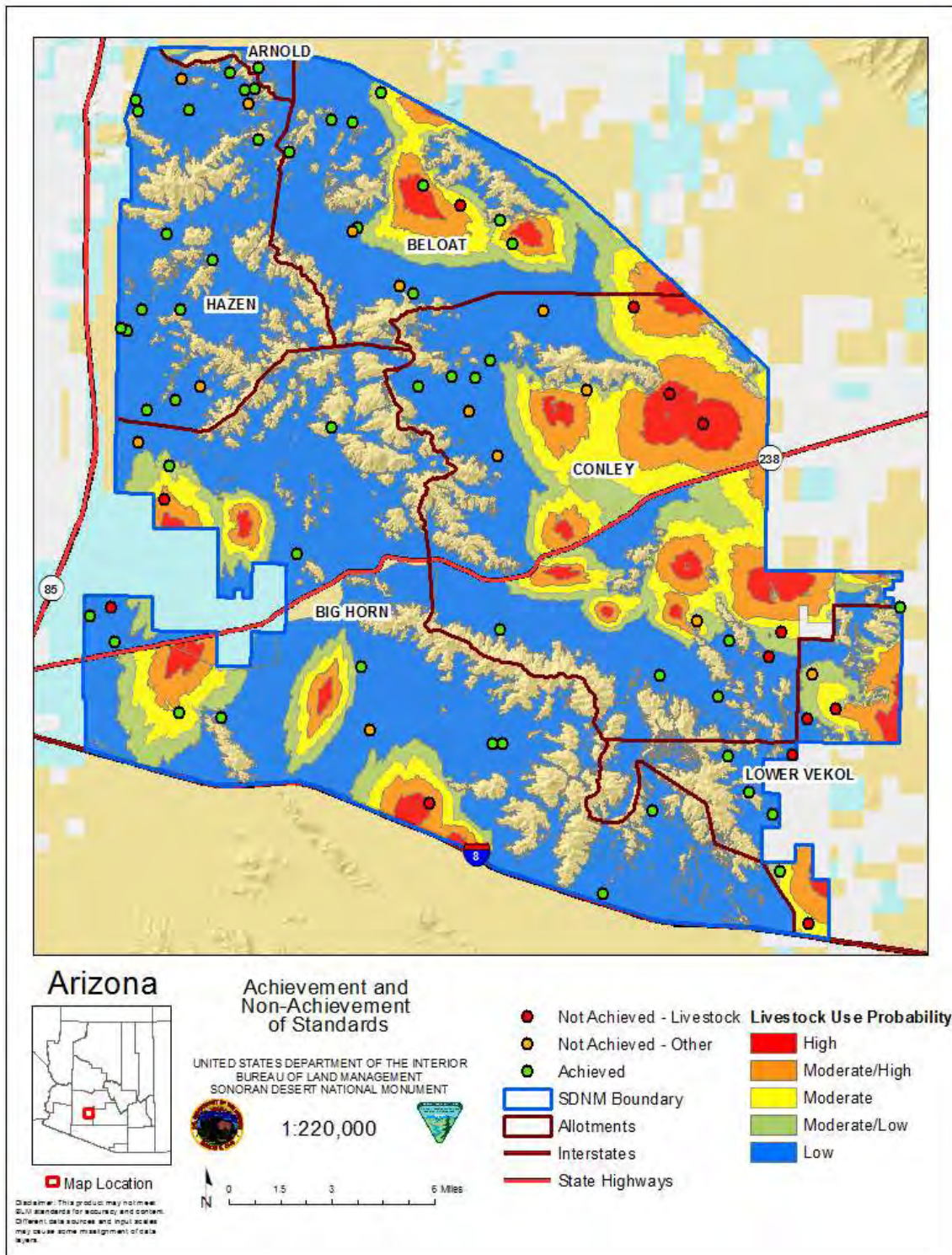
Based on the field observations and monitoring data, it is unlikely that historical livestock grazing is impacting the saguaro cactus forest monument object. However, it is likely that historical livestock grazing has impacted the diversity of plant and animal species, vegetation communities, and wildlife monument objects on the Lower Vekol.

3.7 Monument Wide

The results of the analysis indicate that Standard 1 and 3 are being achieved in many areas throughout the SDNM. However, the majority of areas near livestock waters on the Beloat, Big Horn, Conley, and Lower Vekol allotments are failing to achieve Standard 1 or 3 or both because of current or historical perennial livestock grazing (Map 1). The study of the saguaro cactus forest produced similar results where a smaller proportion of saguaro cactus community less than 50 years old were observed on plots near livestock waters versus plots far from livestock waters. The results of this analysis are consistent with the findings of many studies on the relationship between range condition and distance from livestock waters (Martin & Severson 1988; Pickup & Bastin 1997; Blanco et al. 2009). Livestock grazing, as historically authorized, is unlikely to be compatible with many of the biological monument objects near livestock waters. A summary of compatibility determinations, as discussed above, are listed in Table 4.

Table 4. Compatibility Determination by Allotment (based on grazing as historically authorized)

Allotments	Biological Monument Objects				
	Diversity of Plant and Animal Species	Saguaro Cactus Forests	Scientific Analysis of Plant Species and Climates in Past Eras	Vegetation Communities	Wildlife
Arnold	Compatible	N/A	Compatible	Compatible	Compatible
Beloat	Incompatible	Incompatible	Compatible	Incompatible	Incompatible
Big Horn	Incompatible	Compatible north pasture/Incompatible south pasture	Compatible	Incompatible	Incompatible
Conley	Incompatible	Incompatible	Compatible	Incompatible	Incompatible
Hazen	Compatible	Compatible	Compatible	Compatible	Compatible
Lower Vekol	Incompatible	Compatible	Compatible	Incompatible	Incompatible



Map 1. Plots Achieving and Not Achieving Standard 1 or 3 or Both, Causal Factor for Non-Achievement, and Probability/Potential for Livestock Use on the SDNM

4.0 Archaeological and Historic Objects

In addition to identifying livestock-related impacts on biological objects of SDNM, this compatibility study also evaluated livestock-related impacts on archaeological and historic objects, as identified in the Presidential Proclamation. A Class 1 literature search was completed, as per BLM manual section 8110.2.A.2. This review identified any previous surveys and known archeological sites or traditional cultural places within the allotment boundaries and were then compared to known livestock concentration areas. The results on the archaeological/historical evaluation are identified in Table 5.

4.1 Indicators to Evaluate the “Health” of Cultural Monument Objects.

Based on the above discussion, indicators of grazing-related damage could include the following:

- Breakage or displacement of artifacts or features that is clearly associated with livestock grazing use.
- Evidence of trampling that has disturbed archaeological deposits or accelerated processes of erosion at archaeological sites.
- Trampling, loss of vegetation, or other observable effects that impair qualities of setting, feeling, and other aspects of integrity.
- Loss of archaeological context and associated opportunities for scientific research.

4.2 Methodology/Monitoring to Assess “Indicators.”

- Class I inventory: review of existing literature and site records to find reports of grazing-related damage, with follow-up inspections in the field.
- Class III field inventories of areas subject to concentrated livestock use (water sources, corrals, and livestock trails).
- Coordination and information sharing with range conservationists and other resource specialists, to identify and inspect areas subject to erosion or vegetation loss.

4.3 Observed Impacts of Grazing on Cultural Monument Objects.

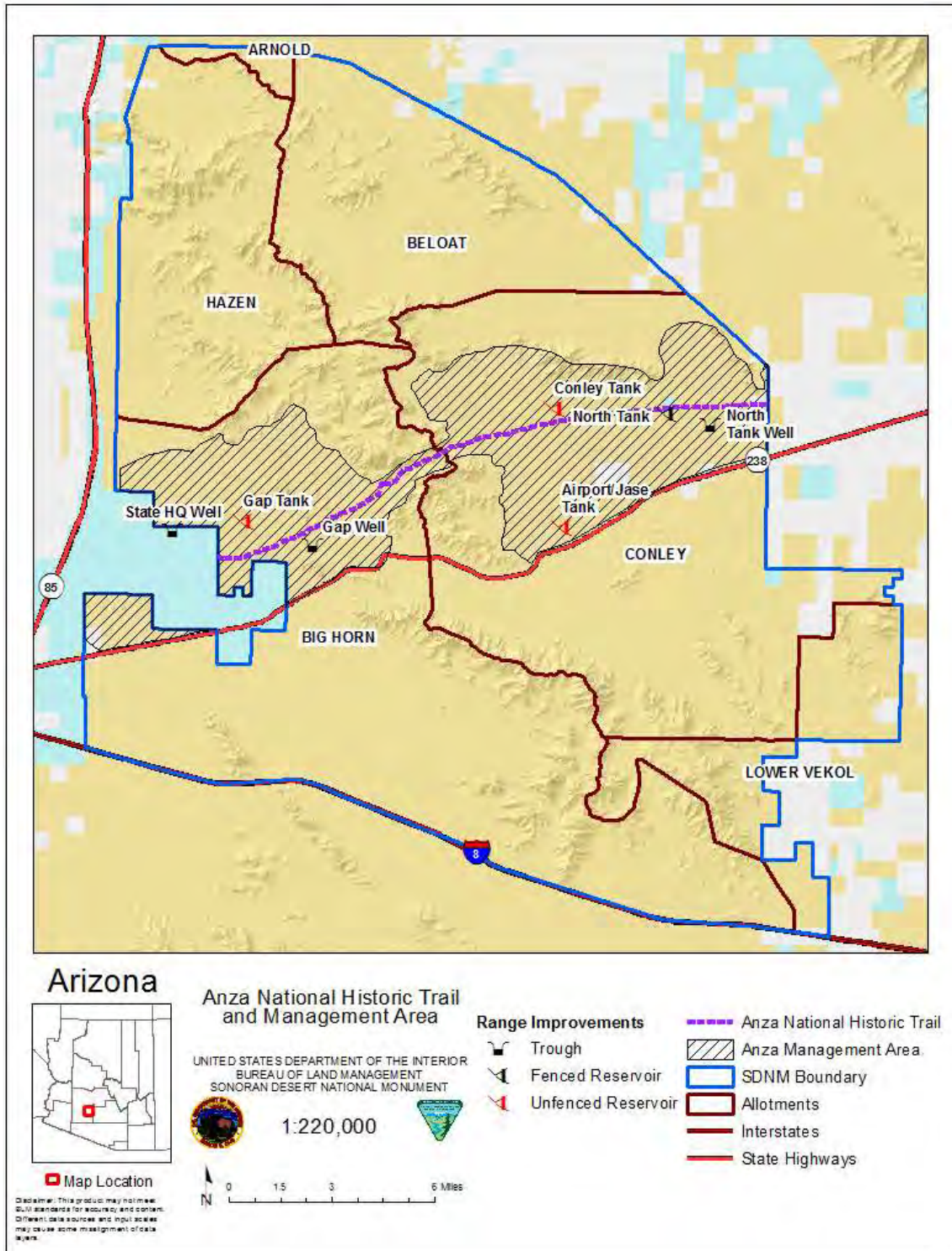
Recent thorough reviews of all previous inventories performed on the SDNM indicate that livestock grazing has had some level of impact on certain known archaeological sites. If the SDNM is available for livestock grazing, the impacts of concentrated livestock use are expected to persist particularly at four locations within the historic trail corridor. These locations include three reservoirs (North Tank, Conley Tank (Conley Reservoir), and Gap Tank) and one well (North Tank Well) (Map 2). These four livestock water developments either overlap or are located in proximity to cultural sites that are historic trails or are an associated cultural site. In addition, all four water developments lay within the Juan Bautista de Anza National Historic Trail Management Area. Prescriptions in the RMP include the management of this area to protect the historic landscapes and visual values of the area in order to provide the visitor with an opportunity to experience vicariously these same values. Concentrated use could threaten these values by trampling and crushing vegetation and creating large barren areas along the trail.

Table 5. Results of the Class I and III inventories (Archaeological/Historical Objects)

Indicator	Evaluation Results
<i>Monument Object: Archaeological and Historic Sites</i>	
Petroglyph Sites	Six petroglyph sites are known on the SDNM north of I-8. These sites are mostly situated in rocky, upland settings and do not exhibit evidence of damage from livestock activities or range improvements. No impacts from grazing have been documented.
Lithic Quarries	The three known lithic quarries north of I-8 are situated on rocky slopes away from livestock activities or range improvements. No impacts from grazing.
Scattered Artifacts	Approximately 23 known cultural sites, listed as artifact scatters, are located north of I-8 on the SDNM. None of these are located within areas of concentrated livestock use. Five additional sites are artifact scatters along a prehistoric trail (footpath).

Indicator	Evaluation Results
<p>Juan Batista de Anza National Historic Trail</p>	<p>Although there are no physical remains, the Anza NHT corridor was designated by Congress in 1991 and the Anza NHT Management Area (Map 2) was allocated in 2012 in the RMP. This Anza Management Area allocation prescribes actions to manage proposed activities in a way that would enhance visitors experience by maintain the integrity of the historic trail and the visual setting (NT.1.1)</p> <p>Four livestock water developments lay within the historic setting and management area of this trail corridor.</p> <p>Gap Tank is low use facility and has low visibility on the visual horizon. Livestock does not tend to gather there in large numbers. No impacts to the trail corridor have been observed.</p> <p>Gap Well was a well and watering station some years ago. Livestock has not gathered there since the water pump failed to produce adequate water supplies. Human use of this impacted area has continued to keep re-vegetation from occurring. Several legacy livestock impact areas have now expanded due to human use. Within the historic trail corridor, it is a moderate impact that may soon be redesigned for use as a trailhead / interpretive station for the Anza NHT corridor.</p> <p>Conley Tank (Conley Reservoir) is located outside of the historic corridor but lays within the Anza NHT Management Area. Visually, the tank is very well screened from the trail by thick vegetation. This tank does not hold water for long periods. The livestock do not tend to concentrate there for long periods. The effect of this tank to the trail corridor is negligible, with a minor effect to the historic setting.</p> <p>North Tank is located on a State land in-holding on the edge of the historic corridor and within the Anza NHT Management Area. This tank functions so well that it typically contains water for extended periods, so livestock have a tendency to congregate there. If grazing is available, it would be likely that livestock would continue to periodically gather there, threatening a moderate level of impact to the historic setting of the Anza NHT Management Area. A redesign of the use pattern of this tank could lower the level of impact to a minor level.</p>

Indicator	Evaluation Results
Mormon Battalion Trail	<p>The Mormon Battalion Trail is a historic route with documented physical features and attributes. Both the Mormon Battalion Trail and the Butterfield Overland Stage Route lay along the same trail tread in the SDNM.</p> <p>The livestock water, North Tank, can be seen about 400 feet south of this historic trail route. Livestock have been known to congregate on the west and northwest side of this water development over the course of many years and have had a moderate level of impact. Along this stretch of trail, livestock trampling has obliterated the trail features and attributes. Crushing, trampling, and destroying vegetation along the historic trail trace has damaged the visibility of it. The direct impact amounts to an area about 11.8 acres.</p> <p>If grazing is available and permitted, it would be likely that livestock would continue to periodically gather there, threatening a moderate level of impact to the historic setting of these trails. A redesign of the use pattern of this tank could lower the level of impact to a minor level.</p>
Butterfield Overland Stage Route	<p>The Butterfield Overland Stage Route is a historic route with documented features and attributes. Both the Mormon Battalion Trail and the Butterfield Overland Stage Route lay along the same trail tread in the SDNM and are documented cultural sites.</p> <p>North Tank is located on a state land in-holding. The livestock water, North Tank, can be seen about 400 feet south of the historic trail route. Livestock have been known to congregate on the west and northwest side of this water development over the course of many years and have had an impact. Along this stretch of trail, livestock trampling has obliterated the trail berms and ruts associated with the trail. Crushing, trampling, and destroying vegetation along the historic trail trace has damaged the visibility of it. The direct impact amounts to an area about 11.8 acres and has impacted roughly 202 feet of historic trail tread. Included in this 11.8 acre disturbed area is an additional associated Butterfield Stage era historic site, known as Desert Station. The crushing and trampling of the site features have contributed to its loss of integrity.</p> <p>If grazing is available, it would be likely that livestock would continue to periodically gather there, threatening a moderate level of impact to the historic setting of these trails. A redesign of the use pattern of this tank could lower the level of impact to a minor level.</p>
Source: Personal Communication, Blanchard. 2020.	



Map 2. Anza National Historic Trail/Management Area and Livestock Grazing Allotments and Range Improvements

5.0 Assess Compatibility of Livestock Grazing on SDNM

Based on the results of this analysis, including the findings of the SDNM Complex LHE, livestock grazing as previously authorized is determined to be incompatible with protection of the biological objects and some of the cultural objects of the SDNM in areas where Standards 1 and 3 of the Arizona Standards for Rangeland Health are not achieved, portions of saguaro cactus forest with low recruitment, and portions of the three cultural trails near livestock waters. Areas where Standards are not achieved, portions of saguaro forest with low recruitment, and impacted cultural areas are primarily within close proximity to livestock watering/congregation areas. This is consistent with the findings of both the 2012 LHE, PBI study, and other studies related to range condition and proximity to livestock water sources (Steenbergh and Lowe 1983; Martin and Severson 1988; Blanco et al. 2009; Ahnmark and Swann 2008; Drezner and Balling 2008; Blanco et al. 2009). However, there are areas with known historical livestock use that are achieving Standards, have saguaro recruitment, and contain cultural areas that are not impacted. Grazing deferment, as seen on the Hazen and portions of the Big Horn, has resulted in the achievement of Standards on the SDNM. Therefore, grazing could be allowed if managed conservatively.

For grazing to exist on the SDNM, north of I-8, the management and/or level of livestock grazing must be altered to make significant progress towards the achievement of Standards. The LHE and compatibility analysis suggest that livestock grazing can remain available on the SDNM north of Interstate 8 ranging from ephemeral use only to 4,232¹ perennially authorized animal unit months (AUMs).

Livestock grazing management, including stocking rates and grazing schemes, of allotments available for grazing will be analyzed in accordance with National Environmental Policy Act on an implementation-level basis in the future.

¹ Based on the average perennially authorized or documented actual use AUMs, prorated by acres, between 2007 and 2018 excluding AUMs authorized for ephemeral use and AUMs previously authorized on allotment and portions of allotments closed under the Proclamation within the SDNM south of I-8.

6.0 Literature Cited

- Ahnmark, E.B. and D.E. Swann. 2008. A history of saguaro cactus monitoring in Saguaro National Park, 1939-2007. Natural Resource Report NPS/SODN/NRR-2009/093. National Park Service, Fort Collins, Colorado.
- Arizona Interagency Range Committee. 1975. Interrelationships of Livestock and Wildlife on Arizona Rangelands.
- Bahre, C.J. 1991. A Legacy of Change: Historic Human Impact on Vegetation of the Arizona Borderlands. Tucson (AZ): The University of Arizona Press.
- Balling, R.C. Jr., J.M. Klopatek, M.L. Hildebrandt, C.K. Moritz, and C.J. Watts. 1998. Impacts of Land Degradation on Historical Temperature Records from the Sonoran Desert. *Climatic Change*. 40:669-681.
- Blanco, L.J., C.A. Ferrando, and F.N. Biurrun. 2009. Remote Sensing of Spatial and Temporal Vegetation Patterns in Two Grazing Systems. *Rangeland Ecology and Management*. 62:445-451.
- BLM. 1985. Lower Gila South Resource Management Plan Environmental Impact Statement. Phoenix District, Arizona Final.
- Brown, P.E. and C.L. Stone. 1982. Granite Reef: A study in desert archaeology. Anthropological Research Papers No. 28. Tempe (AZ): Arizona State University.
- Drezner, T.D. and R.C. Jr. Balling. 2008. Regeneration cycles of the keystone species *Carnegiea gigantea* are linked to worldwide volcanism. *Journal of Vegetation Science*. 19:587-596.
- Hall, J.A., S. Weinstein, and C.L. McIntyre. 2005. The Impacts of Livestock Grazing in the Sonoran Desert: A Literature Review and Synthesis. The Nature Conservancy in Arizona, Tucson.
- Hanrahan, M.P. 1975. Grazing Marginal Ranges in the Southwest. *Journal of Range Management*. 28:245-247.
- Holechek, J.L., T.T. "Red" Baker, and J.C. Boren. 2005. Impacts of Controlled Grazing Versus Grazing Exclusion on Rangeland Ecosystems: What We Have Learned. Agricultural Experiment Station. Cooperative Extension Service. College of Agriculture and Home Economics. New Mexico State University. Range Improvement Task Force Report No.: 57.
- Holechek, J.L., M. Thomas, F. Molinar, and D. Galt. 1999. Stocking desert rangelands: what we've learned. *Rangelands*. 21: 8-12.
- Holechek, J.L. and K. Jr. Hess. 1996. Grazing Lands: Prices, Value, and the Future. *Rangelands*. 18:102-105.

- Martin, S.C. and R.M. Turner. 1977. Vegetation Change in the Sonoran Desert Region, Arizona and Sonora. *Journal of the Arizona Academy of Science*. 2:59-69.
- Martin, S.C. and K.E. Severson. 1988. Vegetation Response to the Santa Rita Grazing System. *Journal of Range Management*. 41:291-295.
- National Research Council. 1994. *Rangeland Health: New Ways to Classify, Inventory and Monitor Rangelands*. National Academy Press. Washington, DC.
- Neff, J.C., R.L. Reynolds, J. Belnap, and P. Lamothe. 2005. Multi-decadal impacts of grazing on soil physical and biogeochemical properties in southeast Utah. *Ecological Applications*. 15:87-95.
- Osborn, A.J., S. Vetter, R.J. Hartley, L. Walsh, and J. Brown. 1987. Impacts of domestic livestock grazing on archaeological resources of Capitol Reef National Park, Utah. U.S. Dept. of the Interior, National Park Service, Midwest Archaeological Center. *Occasional studies in anthropology*. Report No.: 20.
- Pickup, G., and G.N. Bastin. 1997. Spatial Distribution of Cattle in Arid Rangelands as Detected by Patterns of Change in Vegetation Cover. *Journal of Applied Ecology*. 34:657-667.
- Robinett, D. 1992. Drought and Recovery in the Upper Sonoran Desert. *Rangelands*. 14:219-222.
- Steenbergh, W.F. and C.H. Lowe. 1983. *Ecology of the saguaro: III growth and demography*. Department of Interior National Park Service. Washington, D.C.
- Turner, R.M. 1990. Long-term Vegetation Change at a Fully Protected Sonoran Desert Site. *Ecology*. 71:464-477.
- Waser, N.M. and M.V. Price. 1981. Effects of Grazing on Diversity of Annual Plants in the Sonoran Desert. *Oecologia*. 50:407-411.