National Park Service
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Natural Resource Stewardship and Science

Vegetation and Exotic Plant Management

2017 Annual Report For Sand Creek Massacre NHS

Natural Resource Data Series NPS/SAND/NRDS—2018/1172



ON THE COVER

A cottonwood grove at Sand Creek Massacre NHS. NPS Photo.

Vegetation and Exotic Plant Management

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Executive Summary

This report is intended to be used in concert with the Vegetation and Exotic Plant Management Implementation Strategy for Sand Creek Massacre NHS (Sand Creek Massacre NHS 2015). The implementation strategy provides an overview of the initial reference conditions and direction and this report provides the results for 2017 as well as an annual update (adaptation) of the direction based on ongoing results. Reference conditions represent a combination of ecological and cultural values of the Sand Creek Massacre NHS setting. The data used to determine condition of each vegetation unit relative to reference conditions is from the vegetation monitoring surveys conducted by the Southern Plains Network and Southern Plains Fire Group in accordance with Folts-Zettner et al. (2017). The primary management treatments during 2017 were mowing, herbicide application, and reseeding. These treatments were undertaken primarily to control exotic plants, particularly Russian thistle and Kochia. Most treatments were effective during the treatment year but long-term results remain to be determined. Of the 11 transects monitored in 8 management units, all transects had >50% cover of native grasses expected for the unit and no transects exhibited establishment of a monoculture. One transect had >25% bare ground. The same two transects had >10% exotic cover and >5% high-priority exotic plant cover. Three transects each had <50% native grass cover and >15% shrub cover. Only three transects had >15% native forbs. 2017 management actions appear to be improving vegetation conditions as a whole, although several years of continuous management will be required to firmly establish these conditions. A Management Work Plan has been included for 2018.



NPS PHOTO

Winter on the plains at Sand Creek Massacre NHS.

1. Introduction and Background

This document is part of a collaborative effort including the Sand Creek Massacre N.H.S, the Rocky Mountain Exotic Plant Management Program (RM EPMT), the Southern Plains Fire Group (SPFG), and the Southern Plains Network (SOPN). It is also intended to be used in concert with the Vegetation and Exotic Plant Management Implementation Strategy for Sand Creek Massacre NHS (Sand Creek Massacre NHS 2015), where the strategy provides an overview of the initial conditions and direction and this report provides the results for 2017 as well as an annual update (adaption) of the direction based on ongoing results.

2. Methods

2.1. Spatial Units Used For Vegetation Management

Determination of the spatial units used for vegetation management and for this report is described in greater detail in Sand Creek Massacre NHS (2015). They were derived in cooperation with park staff and were based on a combination of Natural Resource Conservation Service (NRCS) Ecological Sites (NRCS 2013), management zones identified in the "preferred" alternative of the Sand Creek Massacre General Management Plan (National Park Service 2015), and historic use and condition (Sand Creek Massacre NHS 2015)(Figure 2.1-1.).

2.2. Vegetation Condition and Management

Overall objectives for vegetation management are presented in the Vegetation and Exotic Plant Management Implementation Strategy Sand Creek Massacre NHS (2015). Success of a given vegetation objective is determined either by achieving the reference condition(s) (below) identified for a given objective or by a trajectory (trend) leading toward the corresponding reference condition within the specified timeframe.

Effectiveness of Treatments

Effectiveness of treatments would typically be determined both qualitatively and quantitatively. However, 2015 was our first season of this approach and before-treatment sampling was not available for most treatments. Thus, qualitative assessments are the primary approach for evaluating treatment effectiveness in 2017.

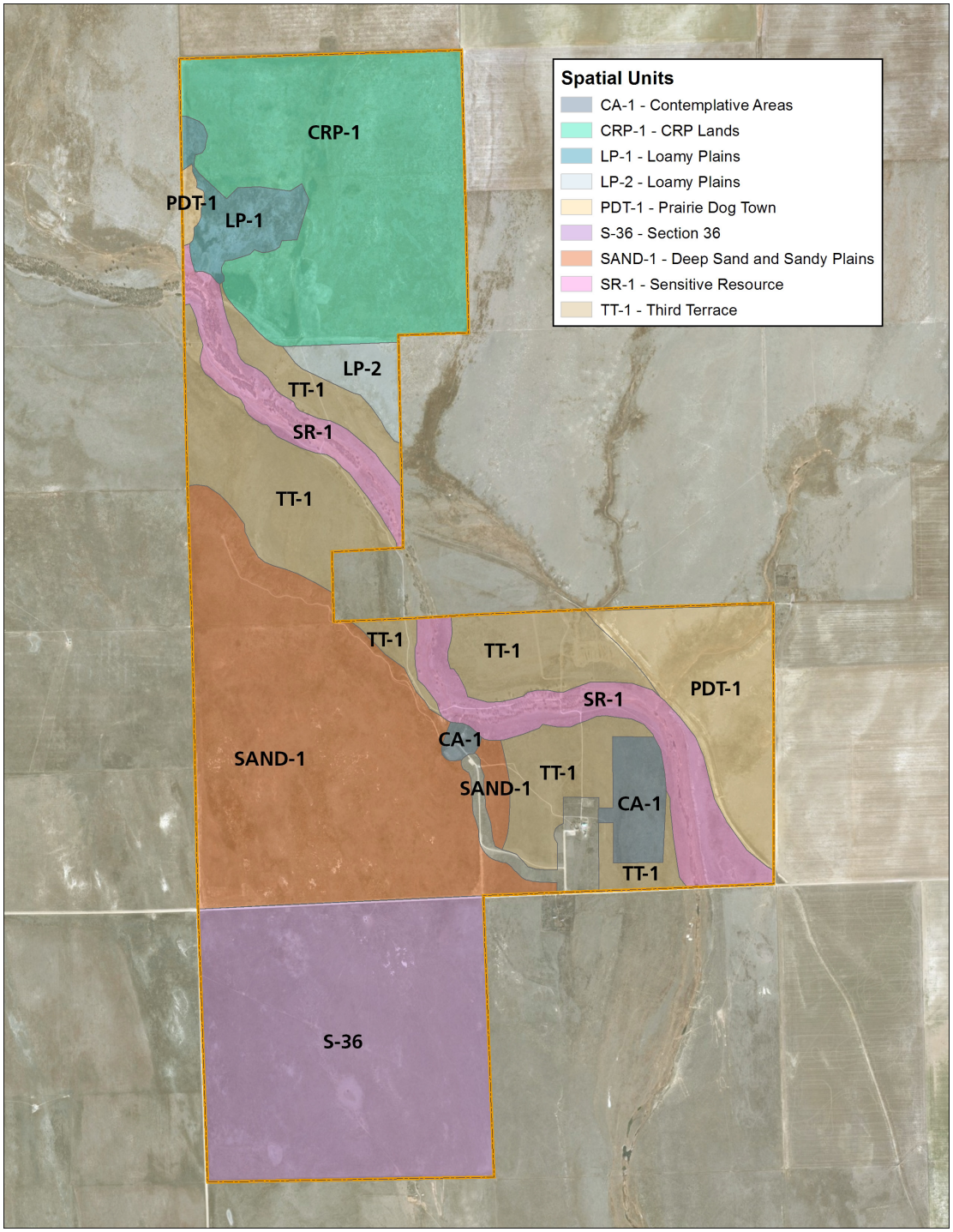


Figure 2.1-1. Spatial units used for the development of a vegetation and exotic plant management strategy at Sand Creek Massacre NHS.

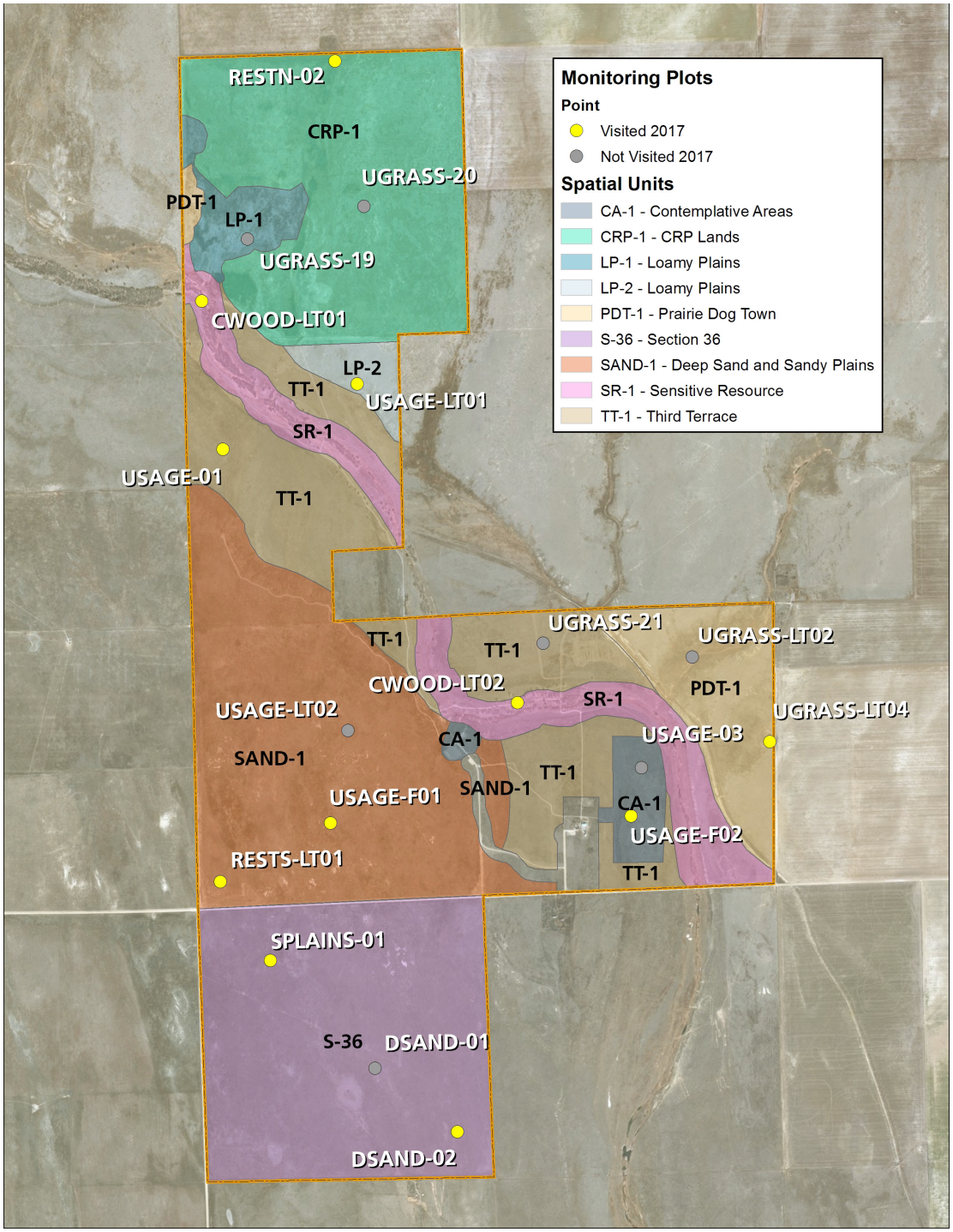


Figure 2.2-1. The existing grassland plots currently being sampled as well as those proposed

Condition of Vegetation Units Relative to Reference Conditions

The data used to determine condition of each vegetation unit relative to reference conditions will be from the vegetation monitoring surveys conducted by the Southern Plains Network and Southern Plains Fire Group in accordance with Folts-Zettner et al. (2017). Transect locations for those data are presented below in Figure 2.2-1.

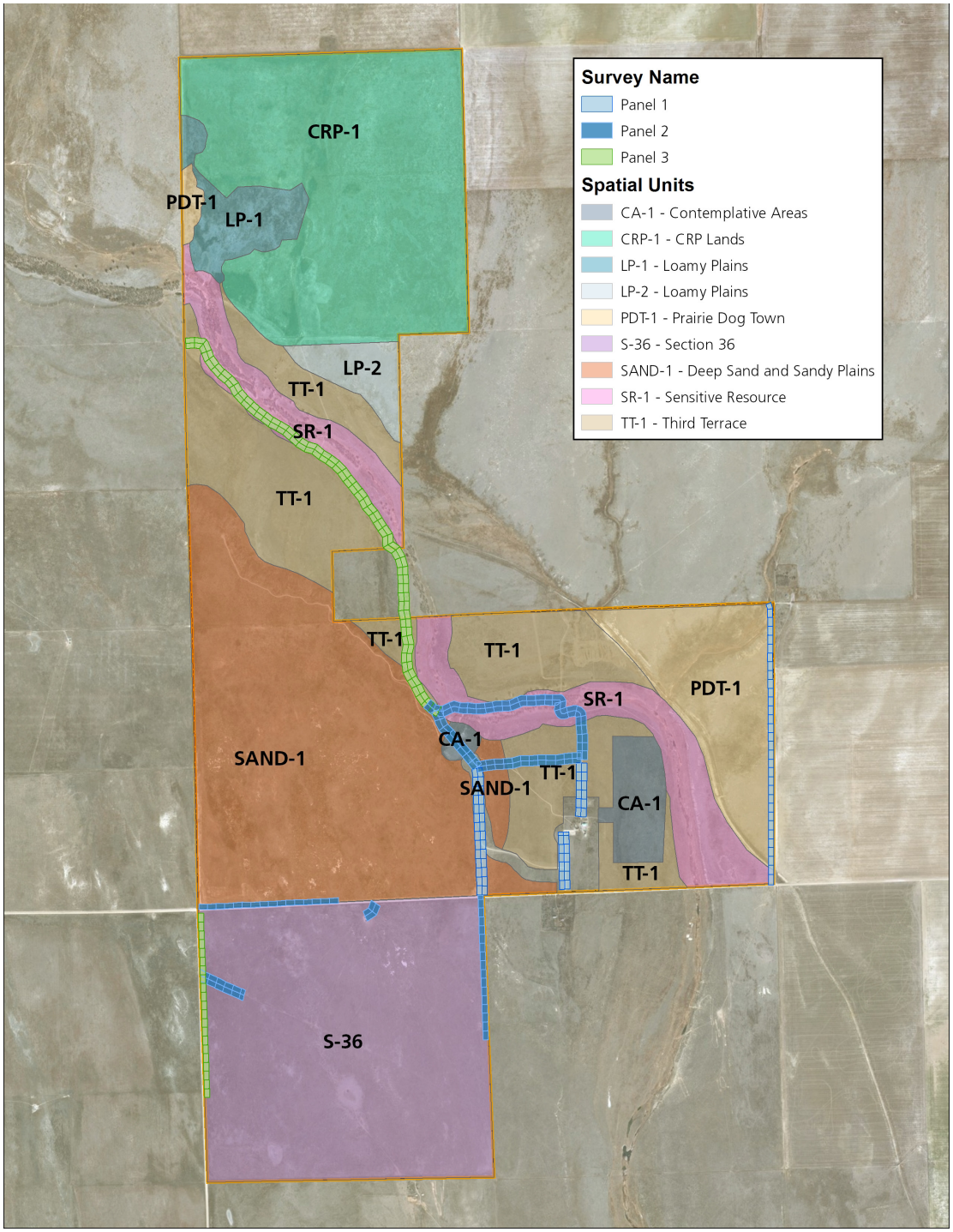


Figure 2.2-2. High risk vectors sampled at Sand Creek Massacre NHS on a 3-year rotating basis.

Exotic Plant Occurrence Along High-Risk Vectors

Most exotics plant species become established by gaining a foothold then gradually expanding their invasion zone and seed bank. For this reason, SOPN monitors the early detection of exotic plant occurrence along selected high-risk vectors (i.e., areas along roads, trails, and boundaries) where initial invasion is more likely to occur. This effort entails a sampling scheme that uses a three-year rotating panel design, whereby a a subset of the high risk vectors are surveyed each year (a panel) for three years, after which the areas surveyed are repeated. Detailed methods are described in Folts-Zettner et al. (2016), and the locations of vectors for SAND are shown below in Figure 2.2-2. Exotic summary report and 2017 vector map can be found in Appendix B.

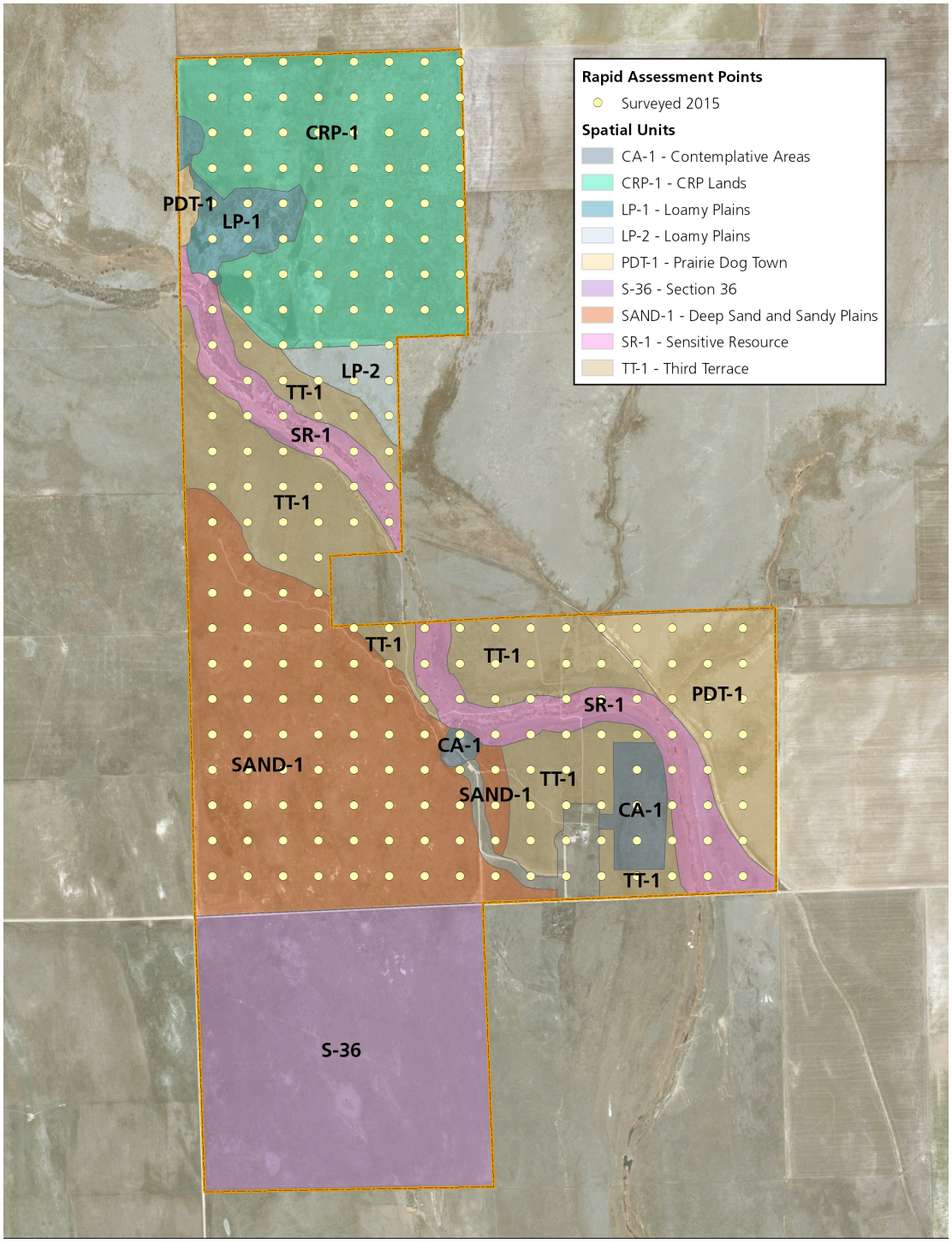


Figure 2.2-3. The exotic plant rapid assessment grid sampled in 2015.

Park-wide Rapid Assessment of Exotic Plants

In addition to the monitoring described above, SOPN conducts a rapid assessment of exotic plants every 4 years using a systematic grid covering the entire park (Figure 2.2-3). The rapid assessment examines the occurrence of a subset of higher priority exotic species within a 10 m radius of points on that grid. The presence and density class of each exotic species is recorded at each point in accordance with Folts-Zettner et al. (2016).

2.3. Reference Conditions For Sand Creek Massacre NHS

We use the term reference conditions to describe our best estimate of resource conditions that are used as a reference point to evaluate the effectiveness of the vegetation management progress. There have been a myriad of terms and concepts centered on

the idea of a resource state that management is trying to achieve. The term "desired condition" is commonly used within NPS as part of the planning process, including those documents undergoing the NEPA process. However, for our purposes, the term desired condition, as it has been used in NPS planning, is too broad and in many cases has uncertainty about very specific resource states that it would be premature to call the desired conditions, particularly in the context of NEPA compliance. Thus, one way to look at how we are using reference conditions here is as a tentative but measurable desired condition.

The reference conditions described below represent a combination of ecological and cultural values of the Sand Creek Massacre NHS setting. They are divided into two categories: (1) Historic Landscape, and (2) Ecological Integrity and Functioning.

Historic Landscape

Overall Goal for the Historic Landscape: To maintain scenic quality and the ability to evoke a sense of place for the historic setting.

For Sand Creek Massacre, the scenic and historic integrity of the viewshed overlap considerably. From the historic perspective, the reference condition is based on the 1864 landscape, the time of the massacre. The scenic quality of the viewshed is influenced primarily by anthropogenic "stuff". The historic connection goes beyond the scenic quality and includes the historic connections between landscape, particularly the River corridor and its cottonwoods, the cliffs, and the surrounding shortgrass prairie.

Historic Reference Conditions

HL1-Historic Landscape: *The historic landscape including vegetation structure and viewshed is consistent with that of the 1864 historic setting.*

Ecological Integrity and Functioning

Landscape Scale Diversity

Overall Goal for Landscape Scale Diversity: The overall goal for landscape diversity at Sand Creek Massacre NHS is for the landscape to reflect a combination of ecological and historic integrity. This integrity is comprised of two major vegetation zones, upland prairie intersected by riparian habitats, with local variation in the expression of these major types reflected by their local environments such as soils and moisture regimes.

Ecological Reference Conditions

EIF1-Landscape Diversity: *The landscape diversity at SAND should generally correspond spatially to the variation expected for the primary ecological sites ecological sites described above and in NRCS (2013).*

EIF2-Native Grass Species Cover: *The grasslands at Sand Creek Massacre NHS should be dominated (>50% cover) by native grass species expected to occur given local site characteristics.*

EIF3-Native Grass Species Composition: *The grass species at Sand Creek Massacre NHS should be species expected under the ecological conditions for a given site based on Ecological Site Descriptions, local records and local expertise. Within a given ecological site, >50% of the grass species cover should by native grass species expected to occur at the given local site.*

EIF4-Grass Species Monocultures: *To avoid monocultures, no individual species should occupy >85% cover within a given ecological site.*

EIF5-Grass Species Biodiversity: *The native species richness of grasses at Sand Creek Massacre NHS should be at least 50% of the number of native species reported to occur within a given ecological site.*

EIF6-Native Forb Cover: *Although grassland sites should be dominated by native grass species, native forbs should occupy > 15% ground cover. It should be noted that the process of restoring native prairies may have an initial temporary stage with < 10%, but there should be an ongoing process of introducing forbs as vegetation management continues.*

EIF7-Forb Species Biodiversity: *The native species richness of forbs at Sand Creek Massacre NHS should be at least 50% of the number of native species reported to occur within a given ecological site.*

EIF8-Exotic Species Occurrence: *Ideally, there would be 100% native species, but exotic species should be maintained at <10% of the overall cover.*

EIF9-Exotic Species Trend: *There should be generally be a decreasing trend in the proportion of exotic plant species, but at least no net increase in the proportion of exotic to native species. Note: this reference condition will only be reported during periodic synthesis reports.*

EIF10- Exotic Species Priority: *Less than 5% of the exotic species should be those considered high priority as per the Sand Creek Massacre NHS Natural Resource Condition Assessment (Struthers et al. 2013)(Table 2.3-1).*

Table 2.3-1. Exotic species found within Sand Creek Massacre NHS that are considered to have the most impact to native habitats throughout the Historic Site based upon combined measures. The logic for this determination can be found in Struthers et al. 2013).

Scientific Name	Common Name
Bromus tectorum (and *var tectorum*)	Cheatgrass
Convolvulus arvensis	Field bindweed
Kochia scoparia (aka *Bassia scoparia*)	Kochia
Melilotus alba/officinalis	White sweetclover/ Yellow Sweetclover
Poa pratensis	Kentucky bluegrass
Salsola tragus	Prickly Russian thistle

EIF11-Grassland Functional Groups: *To maintain the sense of place of prairie, upland grasslands should be dominated by grasses. Native shrubs and subshrubs (e.g., cacti & succulents) probably add diversity to grassland sites, but reflect ecological site conditions, but should not dominate the sites and typically constitute < 15% of the total cover in grasslands.*

EIF12-Riparian Bottomlands Overstory: *To maintain the sense of place of the site, with overstory dominated by stands of native cottonwoods within the sandy bottomland ecological sites.*

EIF13-Pollinator Habitat: *Floral resource abundance and availability is consistent with that expected for the ecological site and sufficient to support healthy populations of native pollinators.*

EIF14-MonarchHabitat: *The abundance, diversity and densities of native milkweeds are consistent with that expected for the ecological site and sufficient to support healthy populations of monarchs where appropriate.*

EIF15-Bare Ground: *The Amount and size of bare areas do not exceed that which would expose the site to excessive erosion, be expected for the ecological site, and does not exceed 25%.*

EIF16-Erosion: *That the presence of rills, gullies, or wind erosion does not exceed that which would naturally be expected for the ecological site and would generally be classified as none to slight.*

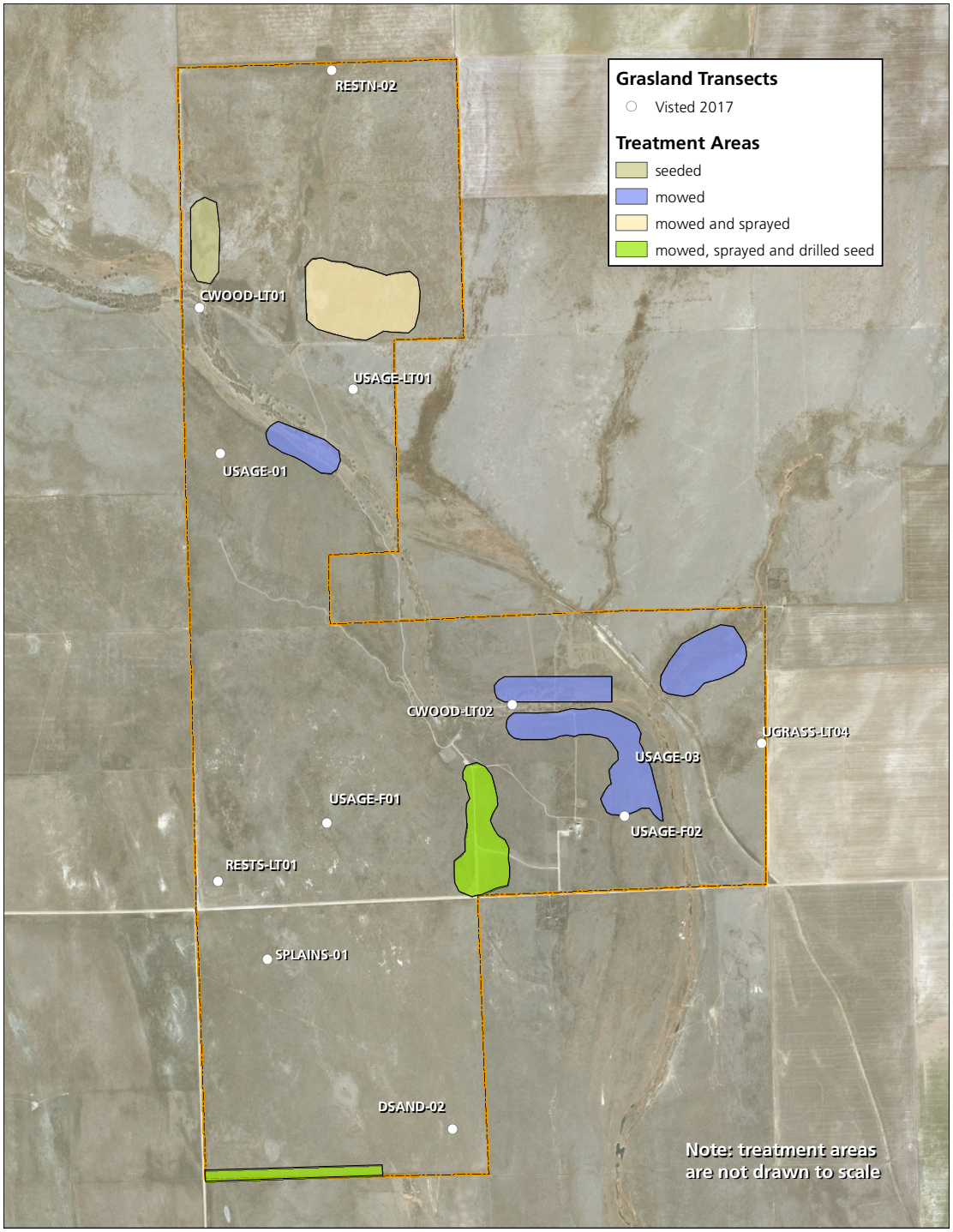


Figure 3.1-1. Location and type of primary vegetation management actions conducted at Sand Creek Massacre NHS during 2017..

3. Results

3.1. Management Treatments

The Location of the primary vegetation/ exotic plant treatments that occurred at Sand Creek during 2017 are shown in Figure 3.1-1. The primary management treatments during 2017 were mowing, herbicide application, and reseeding. These treatments were undertaken primarily to control exotic plants, particularly Russian thistle and Kochia. Prescribed fire was not used during 2017 at Sand Creek. Mowing has been effective in rearranging biomass and decadent growth by depositing it on the ground as litter that acts as mulch and protects the soil against erosion. This treatment often provides an opportunity for a fresh flush of grasses, and if properly timed, can help control annual exotic plants. It appears to be an effective interim alternative to prescribed fire and grazing when those treatments are unavailable.

Table 3.1-1. The primary management actions conducted in each spatial unit at Sand Creek Massacre NHS during 2017. Also shown are the goals, objectives and effectiveness, either qualitative or quantitative for each management action.

Spatial Unit	Desired Condition with Departures	Management Treatment Used	Description of Treatment	Effectiveness of Treatment	Recommended Change in Management (if any)
CRP-1	Reduce populations of high priority exotic plants	Herbicide	Sprayed to control Russian thistle and improve conditions for native grass establishment in mid-June using E2	Reduced cover of Russian thistle from 80% cover to 15% cover (qualitative assessment)	–
	Improve conditions for growth of desired native grasses	Mow	Mowed 30 acres of Russian thistle in Jan-Feb to reduce competition and improve light penetration for native plants	Effective during treatment year. Long-term reduction to be determined.	–
	–	Molasses Experiment	Applied 25 pounds of dried molasses on 1 acre (in 2016) to chipped biomass to assist decomposition	No detectable change	No future treatments
C-1	Improve conditions for growth of desired native grasses	Mow	Mowed sand sage to improve native grass establishment and reduce fuel load (in winter)	Increased cover of native grasses (qualitative assessment)	Continue to expand mow area in unit
LP-1	Improve conditions for growth of desired native grasses	Mow	Spot mowed tall kochia in Jan-Feb to reduce competition and improve light penetration for native plants	Effective during treatment year. Long-term reduction to be determined.	–
	Increase cover of native grasses and reduce bare ground	Seed	Seeded native grasses using Dryland Mix (see below) in Feb-Mar to increase biodiversity and stabilize soil	To be determined	–
LP-2	–	–	No treatment performed	–	–
PDT-1	Improve conditions for growth of desired native grasses	Mow	Spot mowed tall kochia in Jan-Feb to reduce competition and improve light penetration for native plants	Effective during treatment year. Long-term reduction to be determined.	–
S-36	Reduce populations of high priority exotic plants	Herbicide	Sprayed to control Russian thistle and improve conditions for native grass establishment in mid-June using E2	Effective during treatment year. Long-term reduction to be determined.	–
	Improve conditions for growth of desired native grasses	Mow	Mowed Russian thistle during winter to reduce competition and improve light penetration for native plants	Effective during treatment year. Long-term reduction to be determined.	–
	Increase cover of native grasses and reduce bare ground	Seed	Seeded native grasses using Dryland Mix (see below) in Feb-Mar to increase biodiversity and stabilize soil	To be determined	–
	Facilitate establishment of grasses where natural recruitment is not expected	Plug	Transplanted1,000 grass seedlings in May (prior to rain) along southern fenceline along Co Rd V	To be determined	–

Table 3.1-1. The primary management actions conducted in each spatial unit at Sand Creek Massacre NHS during 2017. Also shown are the goals, objectives and effectiveness, either qualitative or quantitative for each management action.

Spatial Unit	Desired Condition with Departures	Management Treatment Used	Description of Treatment	Effectiveness of Treatment	Recommended Change in Management (if any)
SAND-1	Reduce populations of high priority exotic plants	Herbicide	Sprayed to control Russian thistle and improve conditions for native grass establishment in mid-June using E2	Effective during treatment year. Long-term reduction to be determined.	–
	Improve conditions for growth of desired native grasses	Mow	Mow sand sage in south section to improve native grass establishment and reduce fuel load (in winter)	Increased cover of native grasses (qualitative assessment)	–
	Increase cover of native grasses and reduce bare ground	Seed	Seeded native grasses using Dryland Mix (see below) in Feb-Mar to increase biodiversity and stabilize soil	To be determined	–
SR-1	Improve conditions for growth of desired native grasses	Mow	Mow sand sage in south section to improve native grass establishment and reduce fuel load (in winter)	Increased cover of native grasses (qualitative assessment)	–
	Reduce fire fuel load to preserve period cottonwoods	Mow	Mowed north section around period trees in Nov.	Successfully reduced potential effect of fire damage	Mow when vegetation gets tall arouns base of trees
TT-1	Improve conditions for growth of desired native grasses	Mow	Mow sand sage in south section to improve native grass establishment and reduce fuel load (in winter)	Increased cover of native grasses (qualitative assessment)	–
	Reduce fire fuel load to preserve period cottonwoods	Mow	Mowed north section around period trees in Nov.	Successfully reduced potential effect of fire damage	Mow when vegetation gets tall arouns base of trees

Dryland Seed Mix:
western wheat Arriba
buffalo grass Sharp's
sideoats VNS
blue grama VNS
needle & thread VNS
sand dropseed VNS

Supplied by Buffalo Brand Seed, Greeley, CO

Table 3.2-1. Overall summary of reference conditions at Sand Creek Massacre NHS for 2017 Cells in red with a red X indicate that the transect did not meet the reference condition. Cells in green wtih a green dot indicate that the transect did meet the reference condition.

Spatial Unit	Transect	Native Grass	Expected Grass	Native Forb	Monoculture	Exotics	Exotic-High Priority	Native Shrub	Bare Ground
CA-1	USAGE-F02	•	•	X	•	•	•	X	•
CRP-1	RESTN-02	•	•	X	•	•	•	•	•
LP-2	USAGE-LT01	•	•	X	•	•	•	•	•
PDT-1	UGRASS-LT04	•	•	•	•	X	X	•	•
S-36	DSAND-02		•	•	•	•	•	•	X
S-36	SPLAINS-01	X	•	X	•	X	X	X	•
SAND-1	RESTS-LT01	X	•	X	•	•	•	X	•
SAND-1	USAGE-F01	X	•	•	•	•	•	•	•
SR-1	CWOOD-LT01	•	•	X	•	•	•	•	•
SR-1	CWOOD-LT02	•	•	X	•	•	•	•	•
TT-1	USAGE-01	•	•	X	•	•	•	•	•

3.2. Condition of Vegetation Units Relative to Reference Conditions

Based on our monitoring results, the condition of each spatial unit relative to our reference conditions is shown in figures 3.2-1 to 3.2-15. A summary of the refernece conditions is shown in Table 3.2-1. Measurable reference conditions for the historic landscape, landscape diversity, pollinator habitat and monarch butterfly habitat are still being refined and are not shown in this report.

Reference Condition EIF2 - Grassland Species Cover

Prairie or grassland habitats by definition are characterized as being dominated by grasses. The native grasses at SAND are important to stabilize the loose soils and protect against overland flow and wind erosion. As in 2016, all of the sites sampled in 2017 except three in the same management unit (SAND-1) fell within reference conditions (Figure 3.2-1 and Figure 3.2-2). Two of these sites are heavily dominated by sand sage and would probably respond favorably to mowing; both show an increase in grass cover from 2015. These sites do show a slow recovery of grass since the 2013 drought when compared to the other management units at SAND. The third site is on a grazed pasture recently acquired by the park and should gradually improve when cattle are removed after the lease expires. Grass cover dropped at this site from 2015.

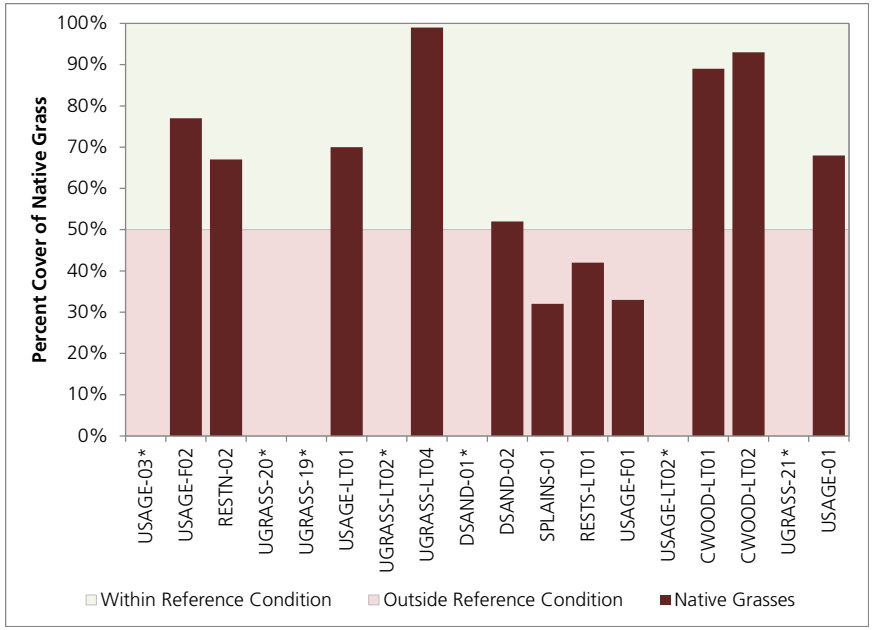


Figure 3.2-1. The percentages cover by native grasses on all of our monitoring plots. Bars within the green portion of the graph are within the reference condition of at least 50% cover by native grasses, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

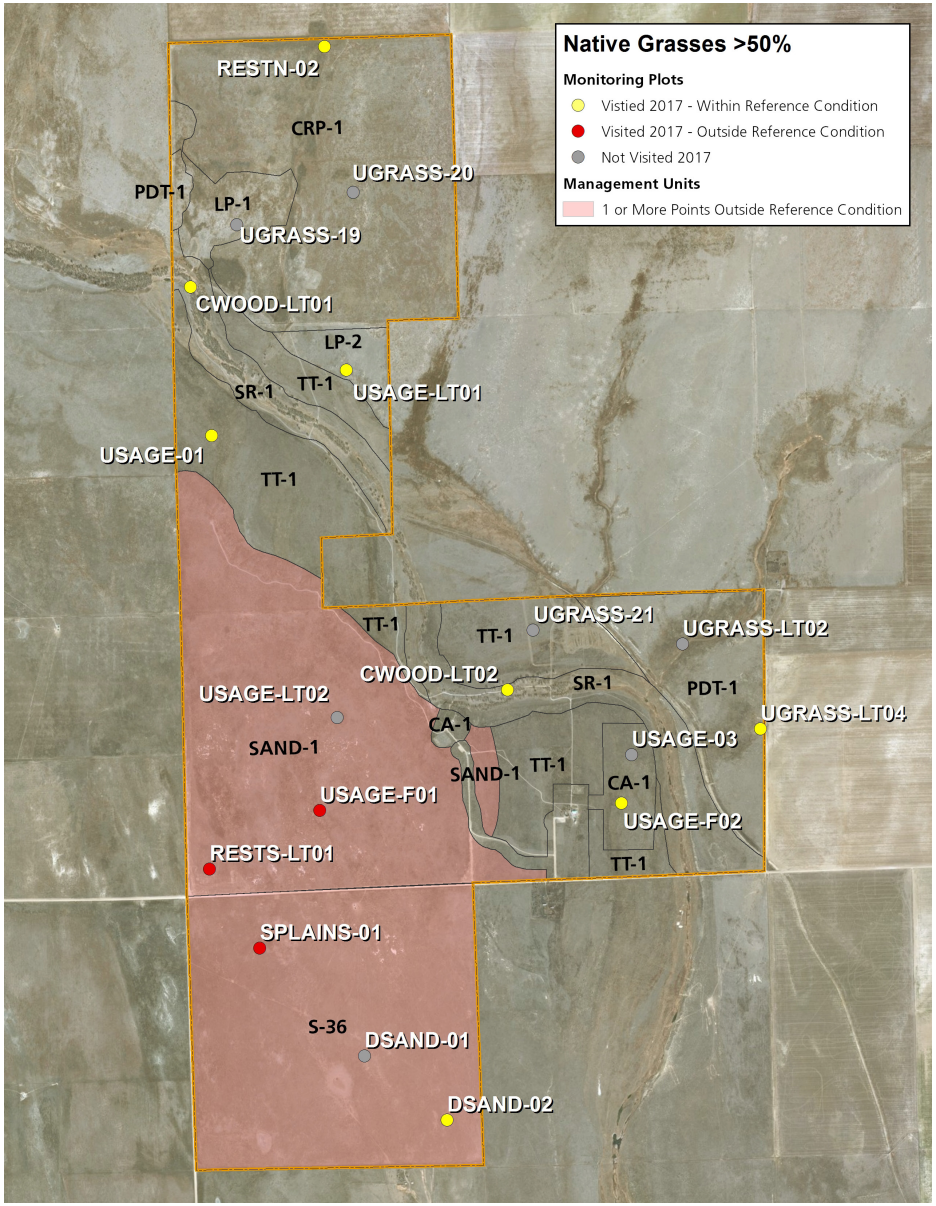


Figure 3.2-2. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the at least 50% cover by native grasses reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF3-Native Grass Species Composition

In addition to cover, we also consider which species are present relative to those expected for the site conditions. A suite of native grasses have been identified that should be present in each fully-realized (climax) plant community, based on Ecological Site Descriptions and local expertise. A variety of native grasses provides an ability to recover quickly from a disturbance and supplies diversity that supports a functioning habitat. All sites monitored in 2017 were within the reference condition.

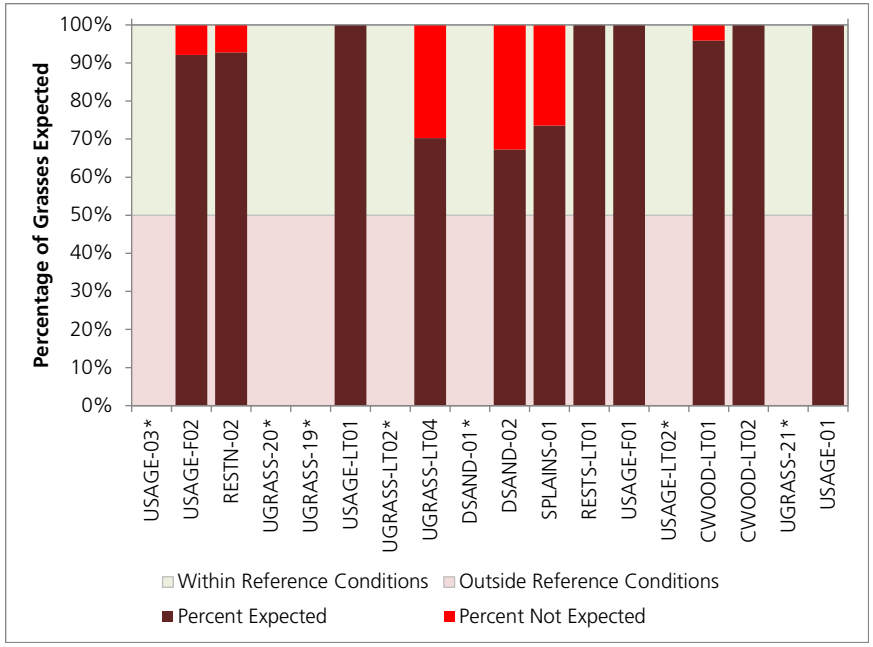


Figure 3.2-3 . The percentage grasses on our monitoring plots that are expected to occur at that site based on ecological site descriptions (NRCS 2011), local expertise, and county records. Bars within the green portion of the graph are within the reference condition of at least 50% cover by native grasses expected to occur at the site, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

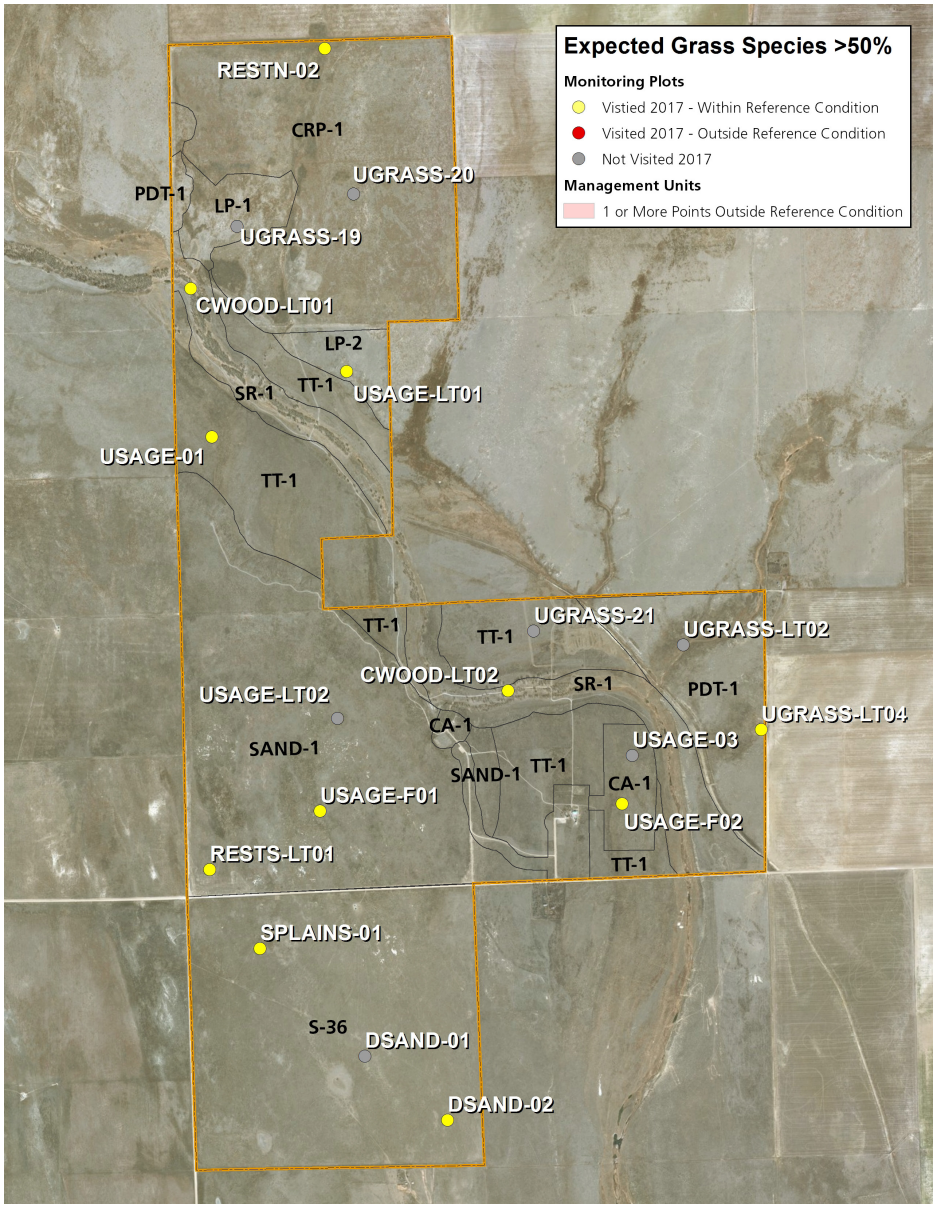


Figure 3.2-4 . Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the at least 50% cover by native grasses expected to occur reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF4-Grass Species Monocultures:

A monoculture occurs when a site is completely dominated by only one grass species. This can result in a lack of diversity, limited habitat quality, and vulnerability to disturbance, although the degree of concern varies depending on species and site characteristics. The one site outside of reference condition (Figure 3.2-5 and Figure 3.2-6) was dominated by western wheatgrass, a rhizomatous grass. Given the immense need to stabilize the soils at Sand Creek, the dominance of this grass is not considered a major problem.

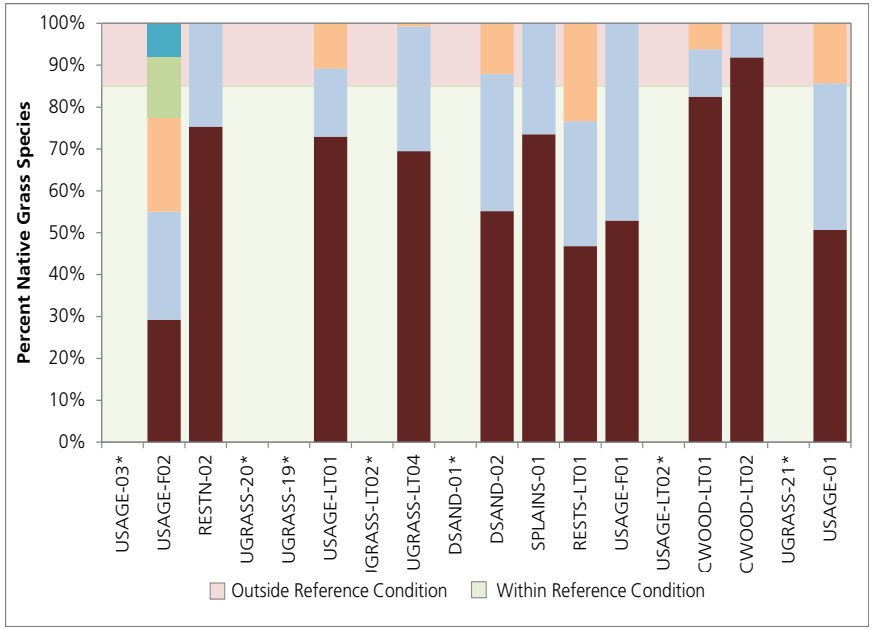


Figure 3.2-5. The percentage individual native grass species on our monitoring plots. Bars within the green portion of the graph are within the reference condition of no individual species having greater than 85% of cover by native grasses, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

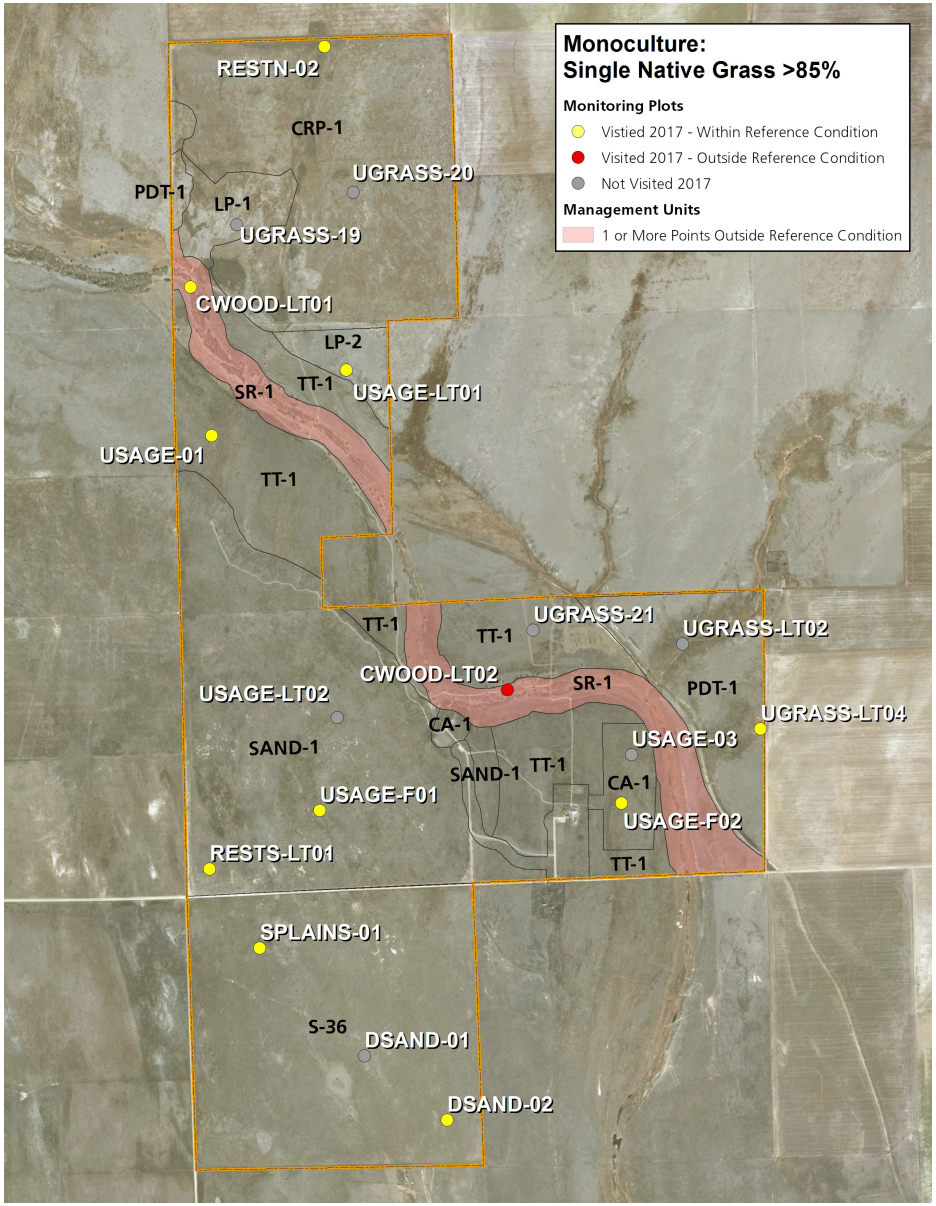


Figure 3.2-6. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no species having greateer than 85% cover by native grasses reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF6-Native Forb Cover

Native forbs are critical for healthy, diverse habitats – providing structure, nectar, pollen, seed and browse to the food-chain and visual interest to the visitor. The three sites ((Figure 3.2-7 and Figure 3.2-8) that meet or exceed the reference condition have a mixture of forbs, but DSAND-02 and USAGE_F01 have a strong component of western ragweed. This native annual is an early successional forb not grazed. In general, native forbs are greatly lacking in the remainder of units at SAND. Establishment of suitable annual and perennial forbs will likely be necessary to meet the reference condition in future years.

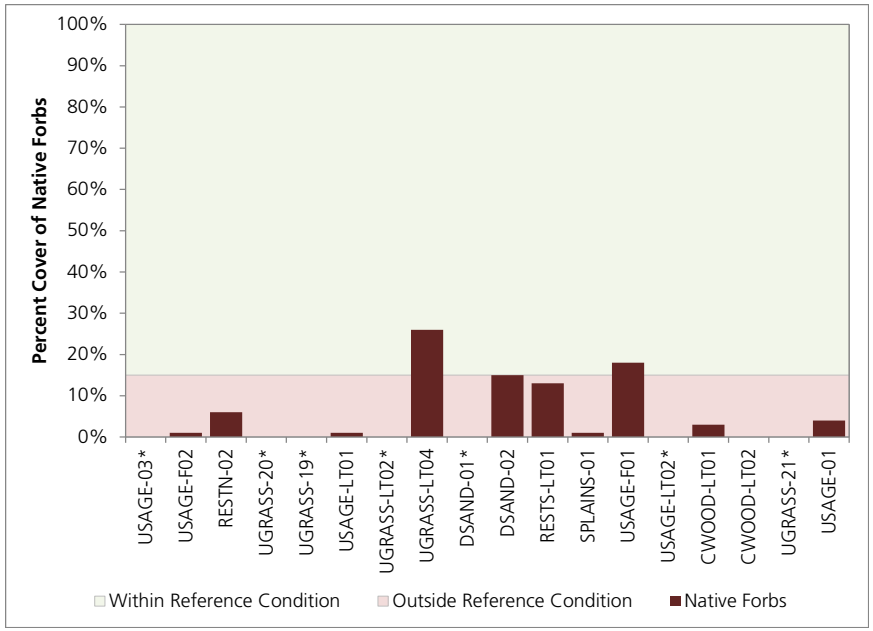


Figure 3.2-7. The percentage cover by native forbs on our monitoring plots. Bars within the green portion of the graph are within the reference condition of having at least 15% cover by native forbs, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

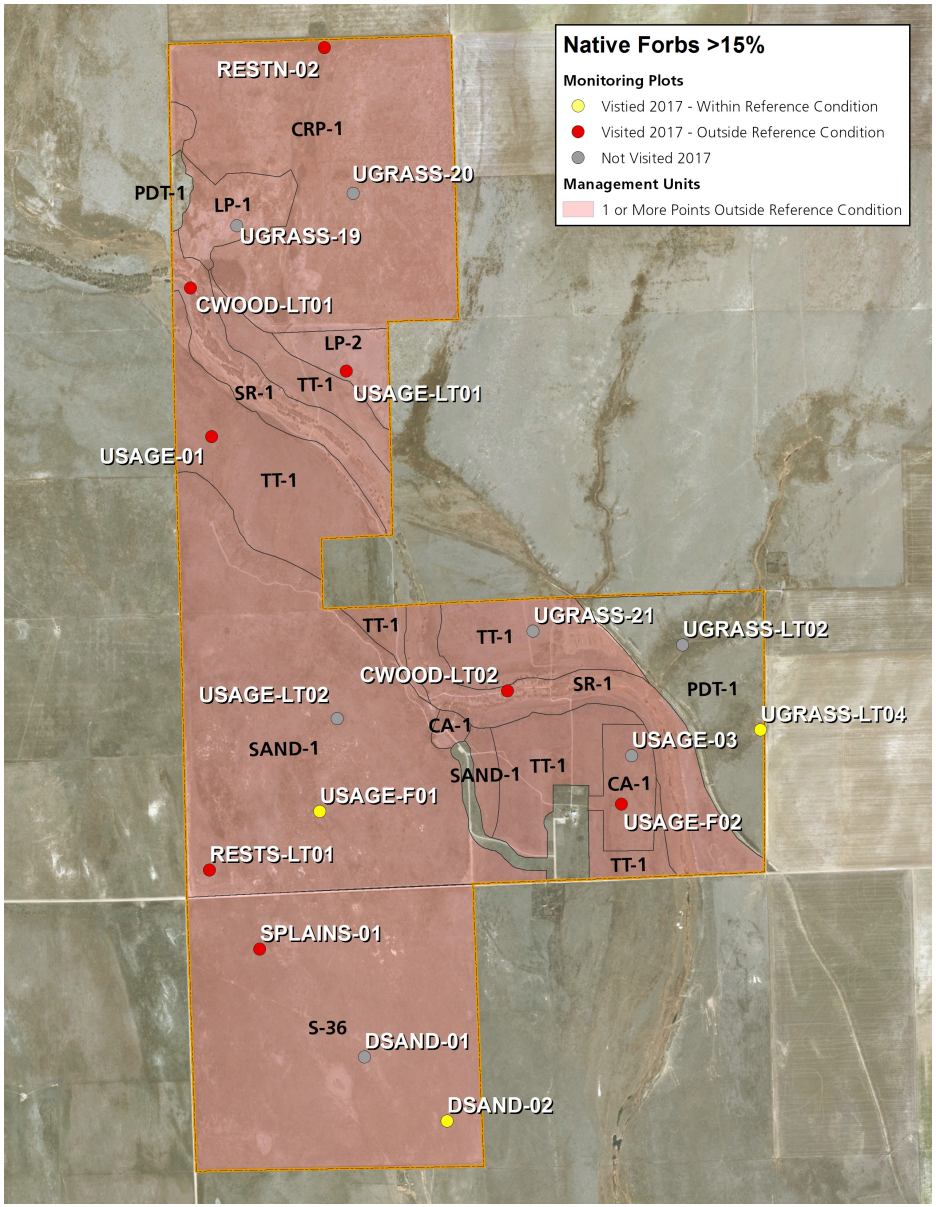


Figure 3.2-8. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the at least 15% cover by native forbs, reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF8-Exotic Species Occurrence:

Exotic species have become commonplace in the landscape with the potential to alter or replace native plant communities when populations become too dense. Restoring and maintaining the resilience of natural areas will discourage the presence of exotics. Of the two sites outside of reference condition, SPLAINS-01 has salsola beginning to establish, while UGRASS-LT04 contains field bindweed at the same level as 2015 (Figure 3.2-9 and Figure 3.2-10). Both species are difficult to control, however the use of well-timed mowing shows promise for breaking the seed bank cycle.

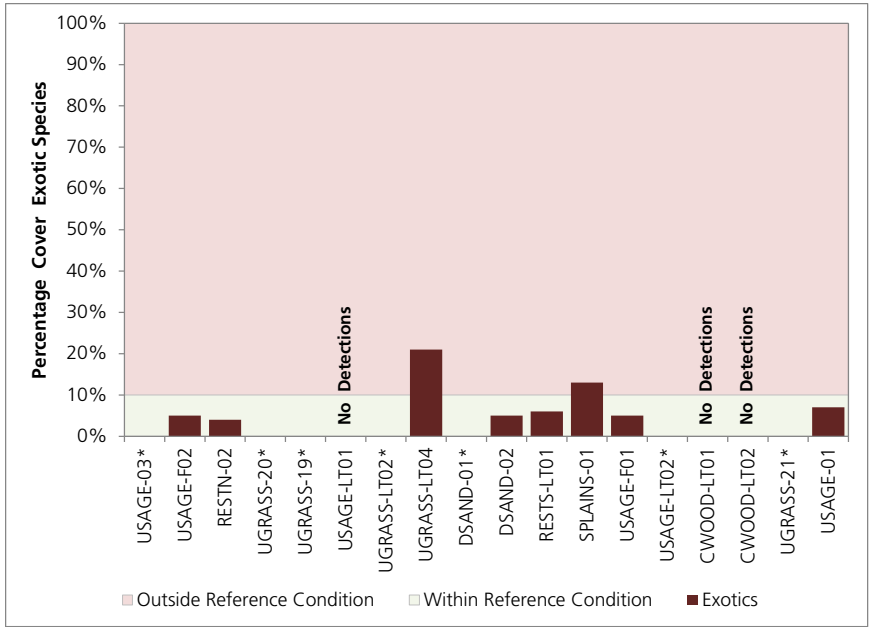


Figure 3.2-9. The percentage cover by exotic species on our monitoring plots. Bars within the green portion of the graph are within the reference condition of having no greater than 10% cover by exotic species, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

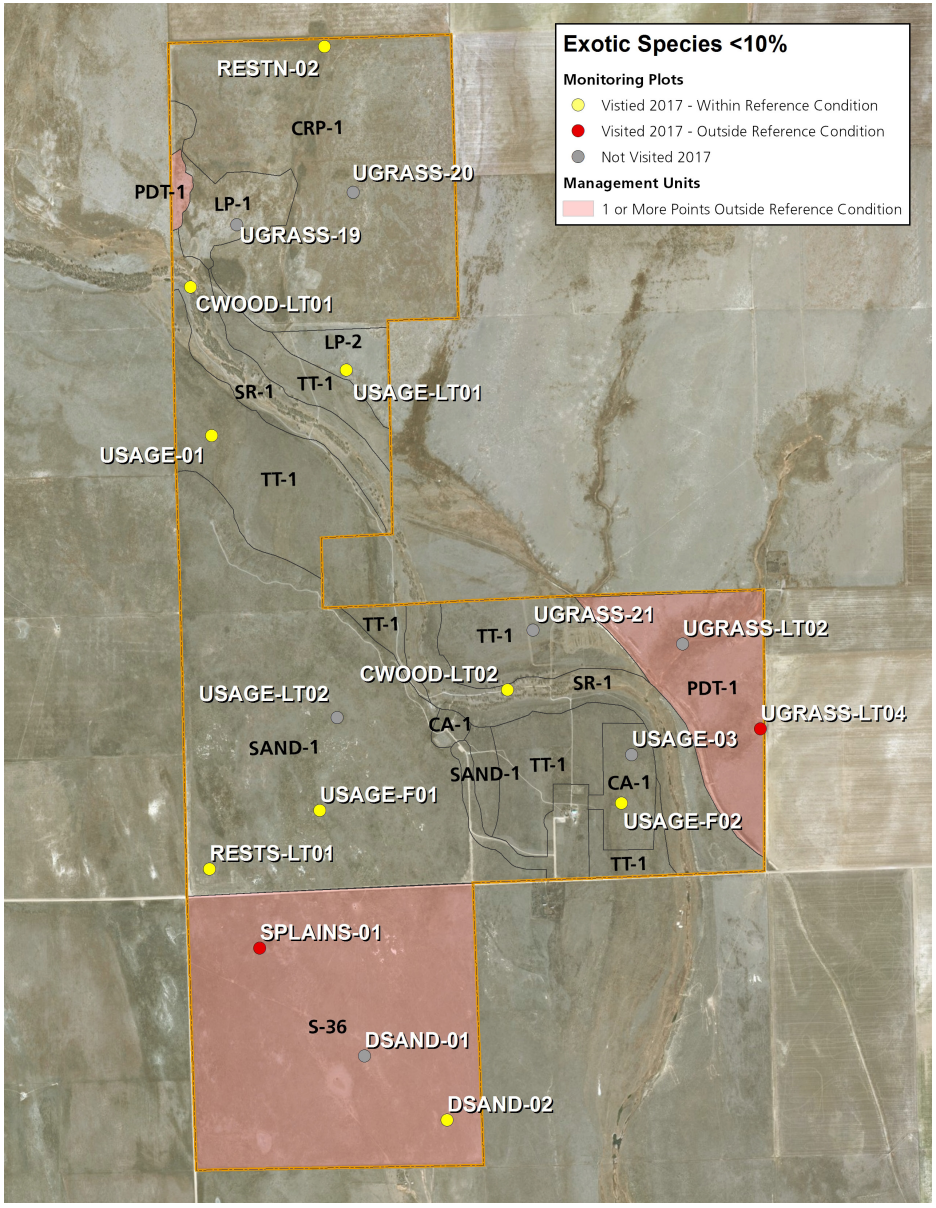


Figure 3.2-10 Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no greater than 10% cover by exotic species reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF10- Exotic Species Priority

Some exotic species are very difficult to control while others diminish with various treatments. Two exotic species at SAND have been identified as high priority exotics for their ability to alter plant communities combined with their difficulty of control. The two sites exceeding the reference condition (Figure 3.2-11 and Figure 3.2-12) are the same as in the previous discussion. Care must be taken when mowing around bindweed. Salsola will exploit bare ground which may be increasing due to grazing.

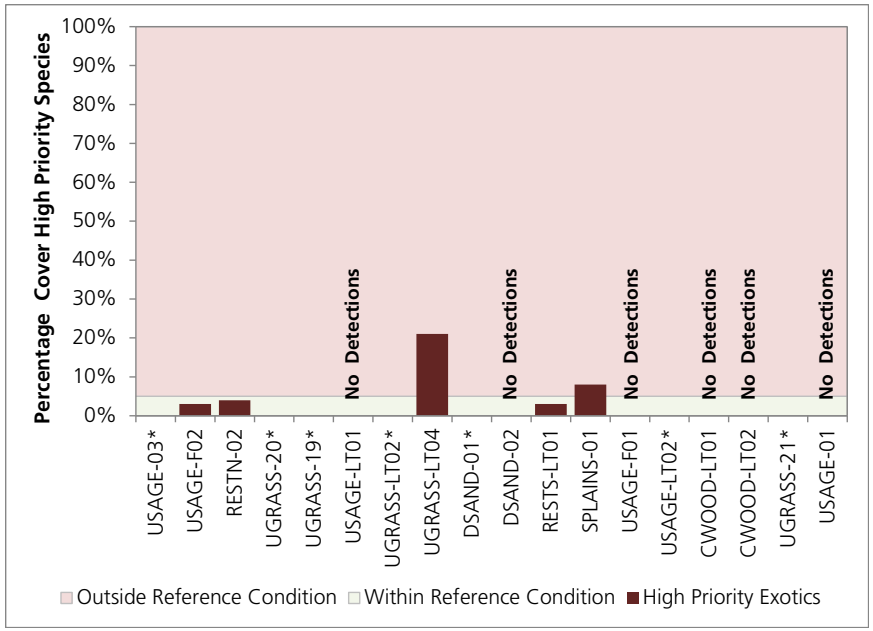


Figure 3.2-11. The percentage of exotic species on each monitoring plots that is considered a high priority species by the park (Struthers et al. 2013). Bars within the green portion of the graph are within the reference condition of having no greater than 5% of the exotic species that are considered high priority, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

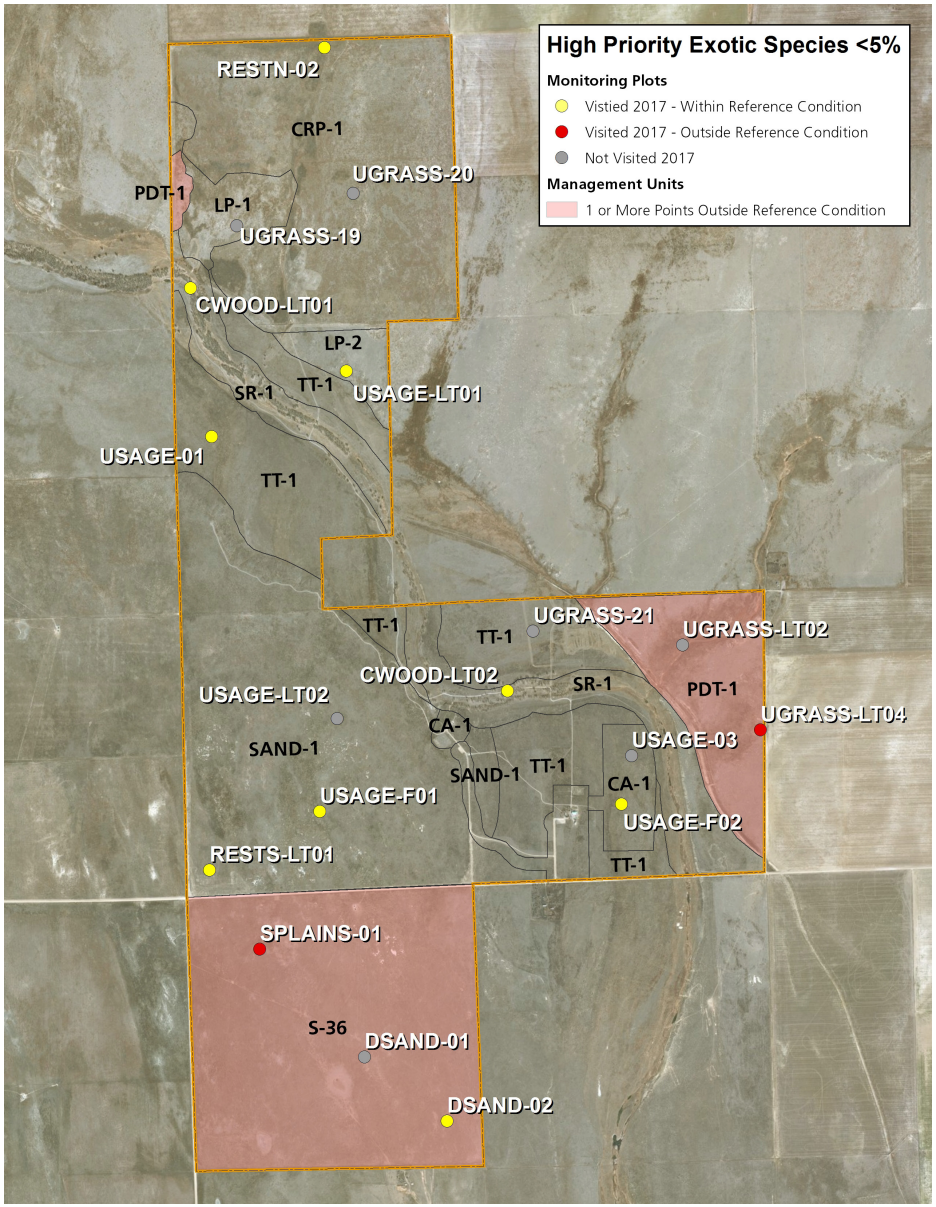


Figure 3.2-12. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no greater than 5% of the exotic species that are considered high priority reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF11-Grassland Functional Groups

Shrubs and subshrubs (cactus, yucca) can be an important component of many habitats, offering food and shelter for wildlife and young plants. Too many shrubs, however, can invade and degrade a grassland, causing a change in the plant community. The three sites exceeding the reference condition (Figure 3.2-16 and Figure 3.217) contain sand sagebrush that has become old and decadent. Treatment should be considered to reduce and refresh these shrubs to an acceptable level. Conversely, there are areas that should have more diverse shrubs, indicating a need for re-establishment of missing shrub species.

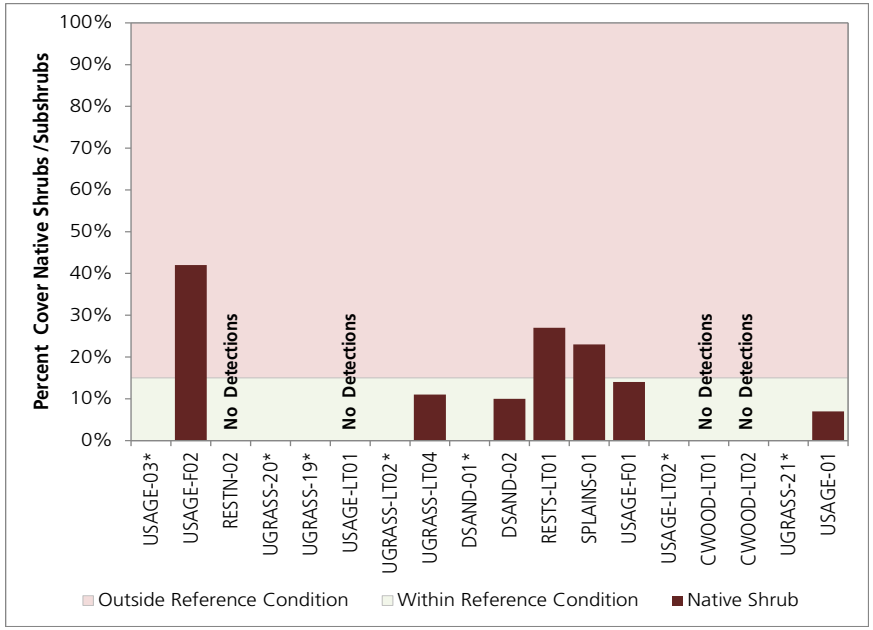


Figure 3.2-16. The percentage of cover by native shrubs on each monitoring plot. Bars within the green portion of the graph are within the reference condition of having no greater than 15% shrub cover, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

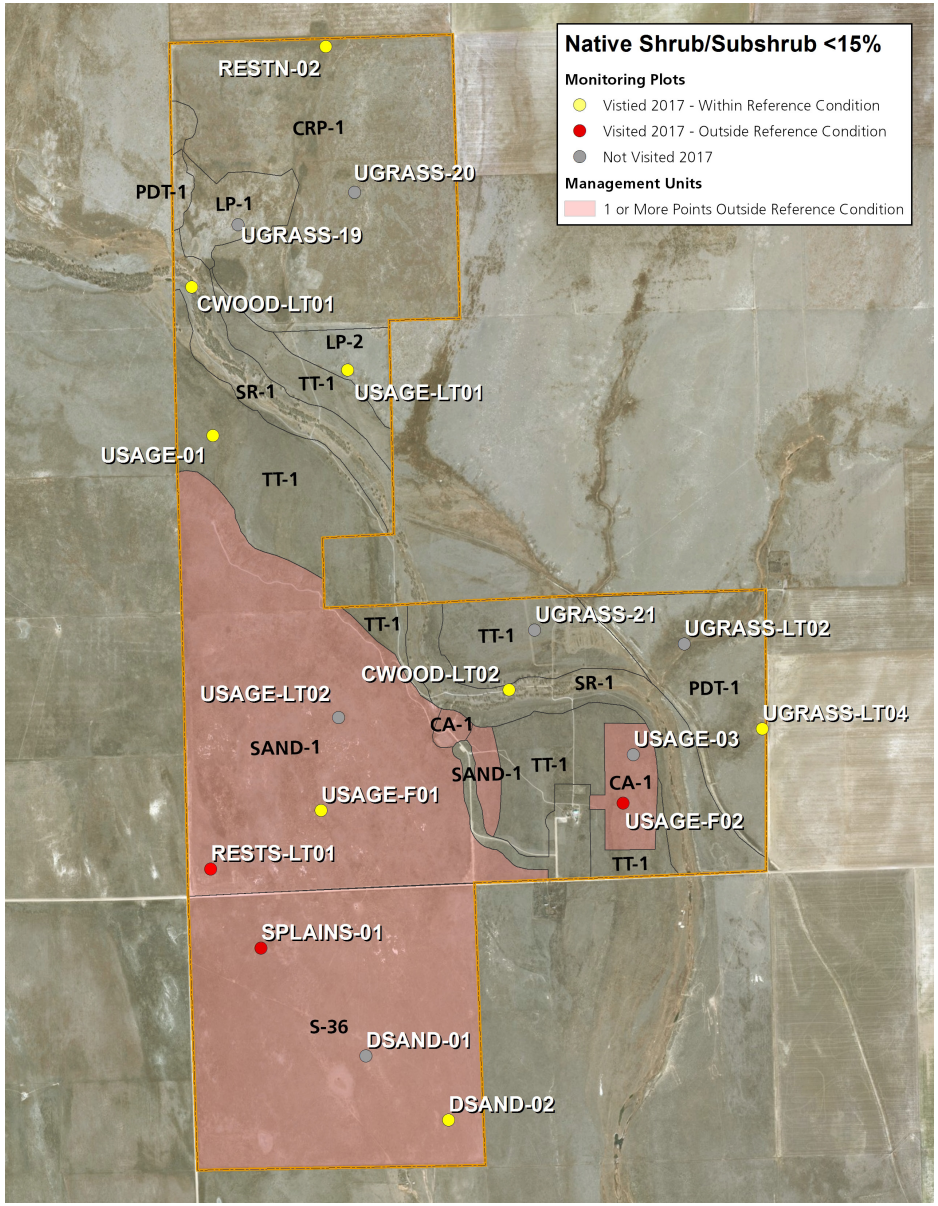


Figure 3.2-17. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no greater than 15% shrub cover reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF15-Bare Ground

The presence of bare ground is necessary for recruitment of new plants, shelter for small mammals and insects, and proper water infiltration. Too much bare, unprotected ground invites erosion (wind or water) and exotic invasion that degrades a plant community. The single site just exceeding the threshold is located in the new grazed unit; other sites monitored in this unit have high bare ground measures, though not yet reaching the threshold. It is possible the combination of deep sand soils and grazing contribute to these higher mesures.

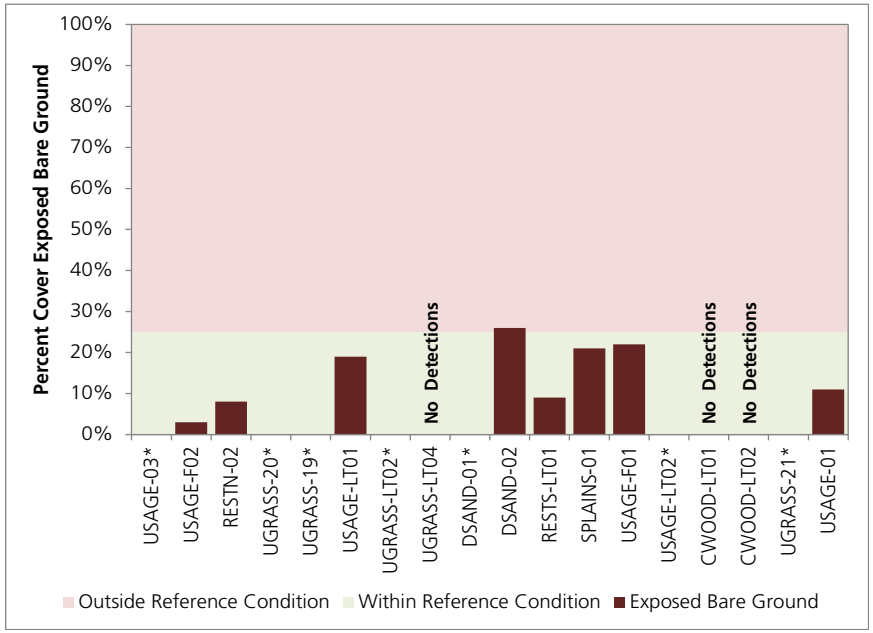


Figure 3.2-14. The percentage of cover by bare ground on each monitoring plot. Bars within the green portion of the graph are within the reference condition of having no greater than 25% bare ground cover, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

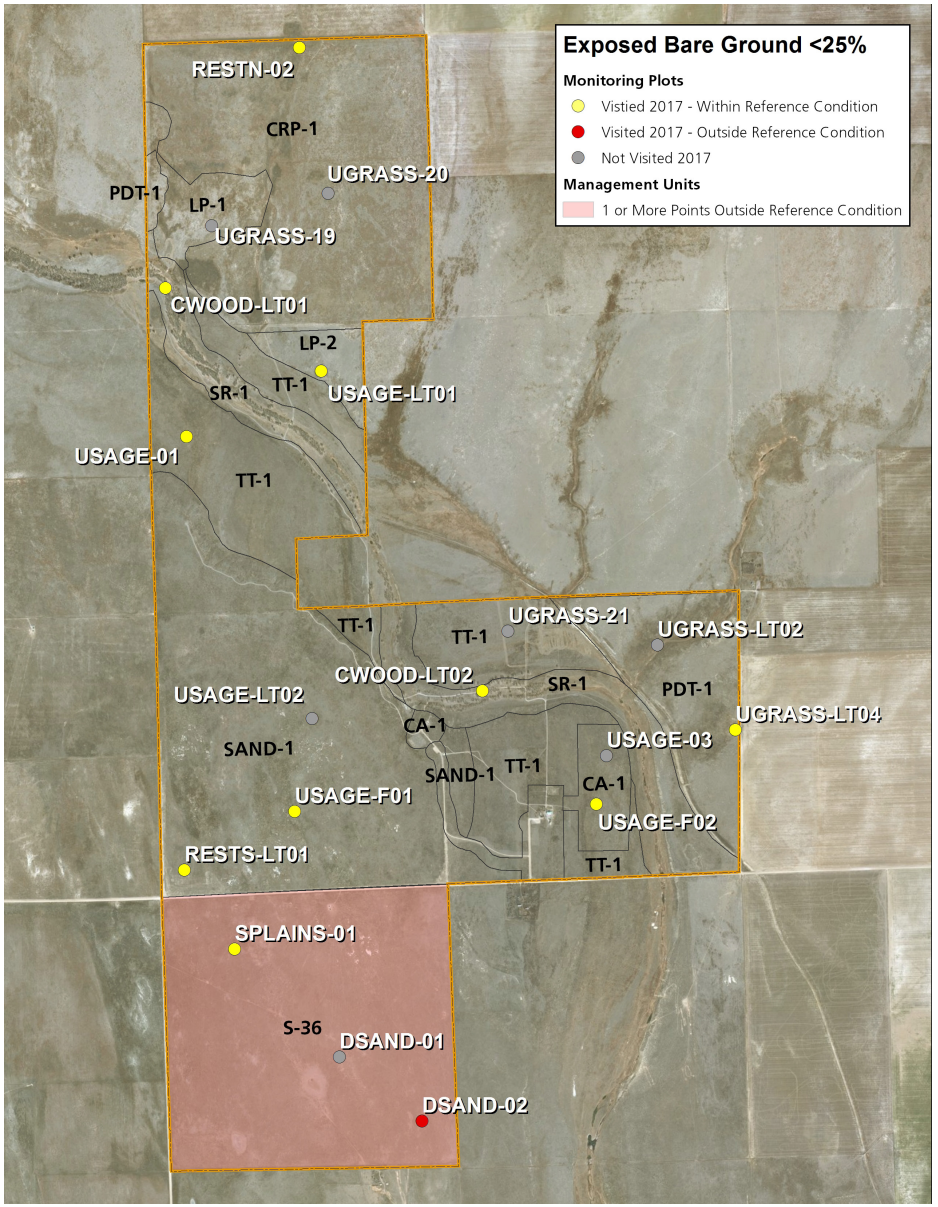


Figure 3.2-15. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no greater than 25% bare ground cover reference condition. The individual plots outside the reference condition are shown in red.

4. Discussion And Adaptation

SAND is a fairly intact landscape that shows great resilience. Land that may have been plowed is limited and if plowed, was only done so once or twice (Zimmermann personal communication). Prior to park establishment, land in the northern portion of the park had been set aside as part of the Conservation Reserve Program which required seeding with native grasses. The newest section of the park has been continuously grazed, which will continue until 2022. During this time, monitoring will continue in the hope that grazing can be assessed as a future management tool at SAND.

Mowing is used in two ways and both appear to be having success. Sand sage dominates the southwest quadrant of the park resulting in decreased native grasses and increased bare ground. Additionally, the sand sage has become decadent with large amounts of woody growth that could provide higher heat if burned. Management at SAND has been mowing discreet areas of sand sage in an attempt to improve the habitat. This has resulted in impressive growth of native grasses, a considerable decrease in bare ground and fresh growth of sand sage. After 4-5 years, the sand sage reaches its former cover but the grasses still persist. The park is now considering whether to re-mow an area to determine what effect this will have on sand sage.

Well-timed mowing of prickly Russian thistle and kochia, followed later by an herbicide application, seems to be breaking their seed cycle. These exotics are mowed when they have good growth but before they can set seed. Mowing too early results in basal growth of these annuals but once they are tall and near seeding mowing results in the death of most plants because they have expended their energy and cannot recover. Subsequent herbicide treatment on any new growth and seedlings has resulted in a flush of native grasses and forbs and decreases bare ground. These efforts will continue for the foreseeable future as the maintenance takes less time and herbicide every year, allowing for other problem areas to be managed.

Transplanting has proven to be more successful than seeding in this semi-arid landscape. As with any plant, timing to coincide with rainfall is critical. Providing supplemental water (when needed) after transplant ensures a good chance of success. While man-power is required to plant and irrigate, the landscape benefits from establishment of more mature plants, less ground is disturbed and less exotic seed bank is released. It also takes fewer years for the transplants to set seed themselves. The transplant program is slated to continue at SAND if rainfall allows.

Fire as a management tool has not been used at SAND. High winds are the norm most of the year in this part of the Plains, rainfall is sporadic and the risk of wildfire is of constant concern to both the park and neighbors. Native grasses in a few areas of the park have become decadent and ground litter thick, signaling the need for prescribed burning. Small patch prescribed fire is therefore being considered.

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Appendix A: 2018 Tentative Workplan

Spatial Unit	Desired Condition with Departures	Management Treatment Used	Description of Treatment	Effectiveness of Treatment	Recommended Change in Management (if any)
CRP-1			No treatment planned	–	–
C-1	Improve conditions for growth of desired native grasses	Mow	Expand mow area to reduce sand sage cover to increase native grasses and facilitate seed collection (in winter)	–	–
LP-1	Reduce populations of high priority exotic plants	Herbicide	Spray for kochia and Russian thistle on south end of unit in mid-June using E2	–	Continue treatment in FY19
	Improve conditions for growth of desired native grasses	Mow	Mow tall kochia and Russian thistle to reduce competition and improve light penetration for native plants on south end of unit in Dec-Jan	–	Continue treatment in FY19
	Increase cover of native grasses and reduce bare ground	Seed	Seed native grasses using Dryland Mix (see below) to increase biodiversity and stabilize soil on south end of unit in Jan-Feb	–	Continue treatment in FY19
LP-2	Improve conditions for growth of desired native grasses	Mow	Mow Russian thistle (in Winter) to reduce competition and improve light penetration for native plants in Spring Creek	–	–
	Increase cover of native grasses and reduce bare ground	Seed	Seed native grasses using Dryland Mix (see below) to increase biodiversity and stabilize soil in Spring Creek in Jan-Feb	–	–
	Reduce populations of high priority exotic plants	Herbicide	Spray to control Russian thistle and improve conditions for native grass establishment in Spring Creek using E2 in mid-June	–	
PDT-1	Improve conditions for growth of desired native grasses	Mow	Mow Russian thistle in February to reduce competition and improve light penetration for native plants in north unit	–	Consider prescribed fire in FY19 or FY20
	Increase cover of native grasses and reduce bare ground	Seed	Seed native grasses in February using Dryland Mix (see below) to increase biodiversity and stabilize soil in north unit	–	–
	Reduce populations of high priority exotic plants	Herbicide	Spray to control Russian thistle and improve conditions for native grass establishment in north unit using E2 in mid-June	–	–
S-36	Improve conditions for growth of desired native grasses	Mow	Mowed 8 acres in SW corner in February to reduce sand sage cover and increase native grass cover	–	Currently grazed
	Improve conditions for growth of desired native grasses	Mow	Mow 10 acres in January at Pullout area and County Road V to reduce sand sage & Russian thistle cover, increase native grass cover, and prepare for transplanting	–	–
	Increase cover of native grasses and reduce bare ground	Seed	Seed native grasses in February using Dryland Mix (see below) to increase biodiversity and stabilize soil in north unit	–	–
	Facilitate establishment of grasses where natural recruitment is not expected	Plug	Transplant 6000 plugs of native grass and forbs in May at Pullout area and County Road V to increase native grass cover	–	–
	Improve conditions for growth of desired native grasses	Irrigate	Supplemental water for transplants 2x week for a month using 200 gal spray tank (if no rain forecasted)	–	–

Spatial Unit	Desired Condition with Departures	Management Treatment Used	Description of Treatment	Effectiveness of Treatment	Recommended Change in Management (if any)
SAND-1	Improve conditions for growth of desired native grasses	Mow	Mowed 10 acres along western boundary in February to reduce sand sage cover, to increase native grass cover, and facilitate future seed collection	–	Continue to mow 10 acres every year until a total of 40 acres have been mowed
	Increase cover of native grasses and reduce bare ground	Seed	Seed native grasses between Dec & March using Dryland Mix (see below) to increase biodiversity and stabilize soil along western boundary	–	–
	Reduce populations of high priority exotic plants	Herbicide	Spray with pre-emergent March-April to control sand bur and improve conditions for native grass establishment along western boundary	–	–
	Facilitate establishment of grasses where natural recruitment is not expected	Plug	Transplant plugs of native grass and forbs in May to increase native vegetation	–	–
SR-1	Reduce fire risk in cottonwood gallery by reducing fuel load	Masticate	Gyrotrack Nov-March Russian thistle accumulation and cottonwood dead fall within the cottonwood gallery to reduce fire fuel load	–	–
TT-1	Improve conditions for growth of desired native grasses	Mow	Mow 8 acres in February to reduce sand sage cover and increase native grass cover	–	–

Appendix B: Exotics Field Summary

Presented is summary data from 2017 exotics monitoring. The first table contains a list of the exotic species detected and the overall number of blocks in which they were found. The second and third tables provides a similar breakdown by transect monitored. The block map depicts the individual blocks monitored(summary presented in the report). These maps can be used with corresponding detailed data found on IRMA (https://irma.nps.gov/DataStore/).

Start Date: 6/20/2017 **End Date:** 6/21/2017

Total Blocks Surveyed: 131

Approx. Length Surveyed (m): 5900

Field Crew: Jonathin Horsley,
Kaitlin O'Brien

Vectors Surveyed: INTERIOR_RD
W_BOUNDARY

Transects Surveyed: SAND_EX_301 total # blocks = 110
SAND_EX_302 total # blocks = 21

Species Found Along All Vectors and Transects

Scientific Name	Common Name	Primary Growth Habit	Duration	Total Blocks
Bromus japonicus	japanese brome	Graminoid	Annual	1
Bromus tectorum	cheatgrass	Graminoid	Annual	1
Carduus tenuiflorus	italian thistle	Forb/Herb	Annual	1
Chenopodium album	common lambsquarters	Forb/Herb	Annual	107
Kochia scoparia	kochia	Forb/Herb	Annual	78
Lactuca serriola	prickly lettuce	Forb/Herb	Annual	1
Salsola tragus	prickly russian thistle	Forb/Herb	Annual	79
Tragopogon dubius	western salsify	Forb/Herb	Annual	12

Species Found Along Individual Vectors and Transects (only transects with exotics are listed):

Vector Name: INTERIOR_RD
Transect ID: SAND_EX_301

Scientific Name	Common Name	# of Blocks with Species
Bromus japonicus	japanese brome	1
Bromus tectorum	cheatgrass	1
Carduus tenuiflorus	italian thistle	1
Chenopodium album	common lambsquarters	93
Kochia scoparia	kochia	72
Lactuca serriola	prickly lettuce	1
Salsola tragus	prickly russian thistle	58
Tragopogon dubius	western salsify	12

Vector Name: W_BOUNDARY
Transect ID: SAND_EX_302

Scientific Name	Common Name	# of Blocks with Species
Chenopodium album	common lambsquarters	14
Kochia scoparia	kochia	6
Salsola tragus	prickly russian thistle	21

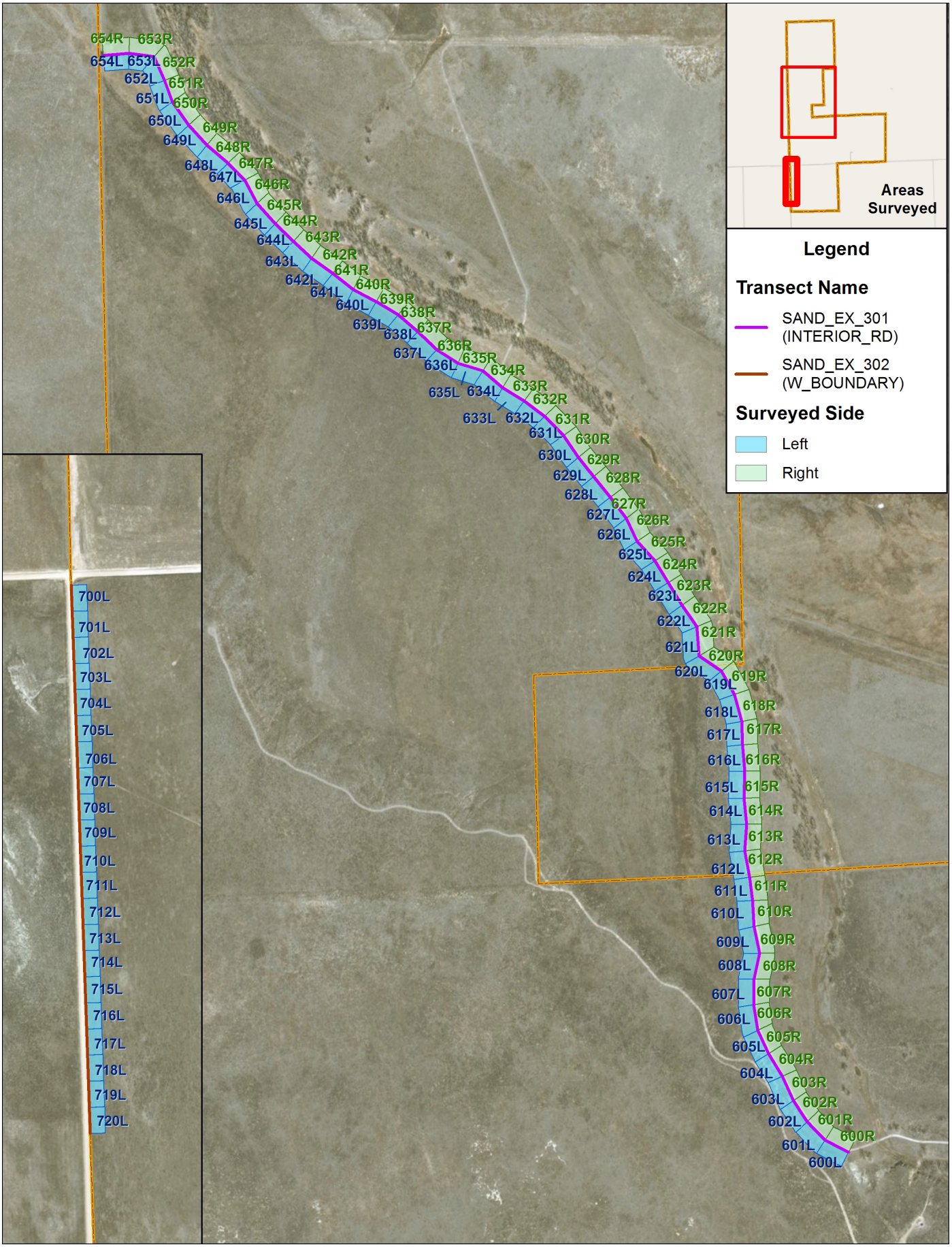


Figure B-1. Exotic monitoring transects visited at Sand Creek Massacre NHS during 2017.

Appendix C: Biodiversity (Rapid Assessment Average Cover)

Community biodiversity is measured in 10 random satellite plots within 100-meters of the transect (Location Name). The cover class (listed at bottom) for that plant in each plot (Cover Sum) is presented, along with the average cover for the community (Average Cover). Points Detected provides the number of plots (N=10) in which each species was detected.

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
CWOOD-LT01	AMBPSI	*Ambrosia psilostachya*	western ragweed	2	2	1
CWOOD-LT01	ASCSUB	*Asclepias subverticillata*	horsetail milkweed	8	5	1.6
CWOOD-LT01	CHEALB	*Chenopodium album*	common lambsquarters	1	1	1
CWOOD-LT01	CHEWAT	*Chenopodium watsonii*	watson's goosefoot	1	1	1
CWOOD-LT01	CROTEX	*Croton texensis*	texas croton	1	1	1
CWOOD-LT01	DISSPI	*Distichlis spicata*	inland saltgrass	8	6	1.33
CWOOD-LT01	ELYCAN	*Elymus canadensis*	canada wildrye	1	1	1
CWOOD-LT01	EUPDAV	*Euphorbia davidii*	davids spurge	1	1	1
CWOOD-LT01	EUPMAR	*Euphorbia marginata*	snow-on-the-mountain	1	1	1
CWOOD-LT01	EUPSER2	*Euphorbia serpyllifolia*	thyme-leaf sandmat	1	1	1
CWOOD-LT01	KOCSCO	*Kochia scoparia*	kochia	10	8	1.25
CWOOD-LT01	LACSER	*Lactuca serriola*	prickly lettuce	2	2	1
CWOOD-LT01	PANCAP	*Panicum capillare*	annual witchgrass	1	1	1
CWOOD-LT01	PANVIR	*Panicum virgatum*	switchgrass	3	3	1
CWOOD-LT01	PASSMI	*Pascopyrum smithii*	western wheatgrass	26	7	3.71
CWOOD-LT01	PHYLAN	*Phyla lanceolata*	lanceleaf frogfruit	1	1	1
CWOOD-LT01	SALTRA	*Salsola tragus*	prickly russian thistle	6	6	1
CWOOD-LT01	SPOAIR	*Sporobolus airoides*	alkali sacaton	10	4	2.5
CWOOD-LT01	VERBRA2	*Verbena bracteata*	bracted vervain: prostrate vervain	1	1	1
CWOOD-LT02	AMBPSI	*Ambrosia psilostachya*	western ragweed	7	5	1.4
CWOOD-LT02	ARTFIL	*Artemisia filifolia*	sand sagebrush	2	2	1
CWOOD-LT02	ASCSUB	*Asclepias subverticillata*	horsetail milkweed	1	1	1
CWOOD-LT02	BOUCUR	*Bouteloua curtipendula*	sideoats grama	3	1	3
CWOOD-LT02	BOUGRA	*Bouteloua gracilis*	blue grama	17	5	3.4
CWOOD-LT02	BRIEUP	*Brickellia eupatorioides*	false boneset brickellbush	1	1	1
CWOOD-LT02	CIRUND	*Cirsium undulatum*	wavyleaf thistle	1	1	1
CWOOD-LT02	DISSPI	*Distichlis spicata*	inland saltgrass	3	3	1
CWOOD-LT02	ELYCAN	*Elymus canadensis*	canada wildrye	1	1	1
CWOOD-LT02	EUPDAV	*Euphorbia davidii*	davids spurge	3	3	1
CWOOD-LT02	HELPET	*Helianthus petiolaris*	prairie sunflower	1	1	1
CWOOD-LT02	LITINC	*Lithospermum incisum*	fringed puccoon	1	1	1
CWOOD-LT02	PANVIR	*Panicum virgatum*	switchgrass	1	1	1
CWOOD-LT02	PASSMI	*Pascopyrum smithii*	western wheatgrass	35	9	3.89
CWOOD-LT02	PHYLAN	*Phyla lanceolata*	lanceleaf frogfruit	1	1	1
CWOOD-LT02	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	2	2	1
CWOOD-LT02	SPOAIR	*Sporobolus airoides*	alkali sacaton	6	3	2
CWOOD-LT02	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	5	5	1
CWOOD-LT02	SYMERI	*Symphyotrichum ericoides*	white heath aster	3	3	1

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
DSAND-02	AMBPSI	*Ambrosia psilostachya*	western ragweed	10	8	1.25
DSAND-02	ARIPUR1	*Aristida purpurea*	purple threeawn	11	9	1.22
DSAND-02	ARTFIL	*Artemisia filifolia*	sand sagebrush	8	8	1
DSAND-02	ASTMOL	*Astragalus mollissimus*	wooly milkvetch	1	1	1
DSAND-02	BOUDAC	*Bouteloua dactyloides*	buffalograss	4	1	4
DSAND-02	BOUGRA	*Bouteloua gracilis*	blue grama	1	1	1
DSAND-02	CHEALB	*Chenopodium album*	common lambsquarters	8	8	1
DSAND-02	CIRUND	*Cirsium undulatum*	wavyleaf thistle	1	1	1
DSAND-02	CROTEX	*Croton texensis*	texas croton	1	1	1
DSAND-02	DALCAN	*Dalea candida*	slender white prairie clover	1	1	1
DSAND-02	ELYELY	*Elymus elymoides*	bottlebrush squirreltail	1	1	1
DSAND-02	ERIANN2	*Eriogonum annuum*	annual buckwheat	7	7	1
DSAND-02	EUPMIS	*Euphorbia missurica*	prairie sandmat	1	1	1
DSAND-02	EVONUT	*Evolvulus nuttallianus*	shaggy dwarf morning glory	10	9	1.11
DSAND-02	HYMTEN	*Hymenopappus tenuifolius*	chalkhill woolywhite	1	1	1
DSAND-02	LAPOCC	*Lappula occidentalis*	flatspine sticktight	3	3	1
DSAND-02	LEPDEN	*Lepidium densiflorum*	common pepperweed	1	1	1
DSAND-02	LYGJUN	*Lygodesmia juncea*	rush skeletonplant	2	2	1
DSAND-02	OENSUF1	*Oenothera suffrutescens*	scarlet guara	1	1	1
DSAND-02	PACNEO	*Packera neomexicana*	new mexico groundsel	3	3	1
DSAND-02	PHYLON	*Physalis longifolia*	longleaf groundcherry	2	2	1
DSAND-02	PLAPAT	*Plantago patagonica*	woolly plaintain	1	1	1
DSAND-02	PSOTEN	*Psoralidium tenuiflorum*	slimflower scurfpea	4	4	1
DSAND-02	SALTRA	*Salsola tragus*	prickly russian thistle	2	2	1
DSAND-02	SCHPAN	*Schedonnardus paniculatus*	tumblegrass	1	1	1
DSAND-02	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	10	9	1.11
DSAND-02	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	15	10	1.5
DSAND-02	SYMERI	*Symphyotrichum ericoides*	white heath aster	2	2	1
DSAND-02	TALAUR	*Talinum aurantiacum*	orange flameflower	1	1	1
DSAND-02	XANSPI	*Xanthisma spinulosum*	lacy tansyaster	6	5	1.2
RESTN-02	ASTCRA	*Astragalus crassicarpus*	ground-plum	1	1	1
RESTN-02	BOUCUR	*Bouteloua curtipendula*	sideoats grama	30	8	3.75
RESTN-02	BOUGRA	*Bouteloua gracilis*	blue grama	16	4	4
RESTN-02	CHEALB	*Chenopodium album*	common lambsquarters	5	4	1.25
RESTN-02	ELYELY	*Elymus elymoides*	bottlebrush squirreltail	2	2	1
RESTN-02	HELANN	*Helianthus annuus*	common sunflower	3	3	1
RESTN-02	KOCSCO	*Kochia scoparia*	kochia	3	3	1
RESTN-02	LEPDEN	*Lepidium densiflorum*	common pepperweed	1	1	1
RESTN-02	LYGJUN	*Lygodesmia juncea*	rush skeletonplant	3	3	1
RESTN-02	SALTRA	*Salsola tragus*	prickly russian thistle	3	3	1
RESTN-02	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	10	9	1.11
RESTN-02	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	7	6	1.17
RESTN-02	SYMERI	*Symphyotrichum ericoides*	white heath aster	1	1	1
RESTN-02	XANSPI	*Xanthisma spinulosum*	lacy tansyaster	1	1	1
RESTS-LT01	AMBPSI	*Ambrosia psilostachya*	western ragweed	11	10	1.1

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
RESTS-LT01	ARIPUR1	*Aristida purpurea*	purple threeawn	6	4	1.5
RESTS-LT01	ARTFIL	*Artemisia filifolia*	sand sagebrush	16	10	1.6
RESTS-LT01	BOUCUR	*Bouteloua curtipendula*	sideoats grama	8	5	1.6
RESTS-LT01	BOUGRA	*Bouteloua gracilis*	blue grama	9	4	2.25
RESTS-LT01	CHEALB	*Chenopodium album*	common lambsquarters	8	8	1
RESTS-LT01	CROTEX	*Croton texensis*	texas croton	3	3	1
RESTS-LT01	DALCAN	*Dalea candida*	slender white prairie clover	3	3	1
RESTS-LT01	ERIANN2	*Eriogonum annuum*	annual buckwheat	1	1	1
RESTS-LT01	EUPMIS	*Euphorbia missurica*	prairie sandmat	7	6	1.17
RESTS-LT01	EUPSER1	*Euphorbia serpens*	matted sandmat	1	1	1
RESTS-LT01	EVONUT	*Evolvulus nuttallianus*	shaggy dwarf morning glory	4	4	1
RESTS-LT01	HELPET	*Helianthus petiolaris*	prairie sunflower	8	8	1
RESTS-LT01	HETVIL	*Heterotheca villosa*	hairy false goldenaster	1	1	1
RESTS-LT01	LEPDEN	*Lepidium densiflorum*	common pepperweed	4	4	1
RESTS-LT01	LITINC	*Lithospermum incisum*	fringed puccoon	2	2	1
RESTS-LT01	LYGJUN	*Lygodesmia juncea*	rush skeletonplant	2	2	1
RESTS-LT01	OENSUF1	*Oenothera suffrutescens*	scarlet guara	2	2	1
RESTS-LT01	OPUPOL	*Opuntia polyacantha*	plains pricklypear cactus	2	2	1
RESTS-LT01	PSOTEN	*Psoralidium tenuiflorum*	slimflower scurfpea	2	2	1
RESTS-LT01	SALTRA	*Salsola tragus*	prickly russian thistle	8	8	1
RESTS-LT01	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	9	6	1.5
RESTS-LT01	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	10	9	1.11
RESTS-LT01	XANSPI	*Xanthisma spinulosum*	lacy tansyaster	5	5	1
RESTS-LT01	YUCGLA	*Yucca glauca*	soft soapweed yucca	1	1	1
SPLAINS-01	AMBPSI	*Ambrosia psilostachya*	western ragweed	5	5	1
SPLAINS-01	ARIPUR1	*Aristida purpurea*	purple threeawn	8	8	1
SPLAINS-01	ARTFIL	*Artemisia filifolia*	sand sagebrush	3	3	1
SPLAINS-01	CHEALB	*Chenopodium album*	common lambsquarters	21	10	2.1
SPLAINS-01	CHEINC	*Chenopodium incanum*	mealy goosefoot	3	3	1
SPLAINS-01	CROTEX	*Croton texensis*	texas croton	5	5	1
SPLAINS-01	ECHVIR	*Echinocereus viridiflorus*	nylon hedgehog cactus	1	1	1
SPLAINS-01	ERIANN2	*Eriogonum annuum*	annual buckwheat	6	6	1
SPLAINS-01	EVONUT	*Evolvulus nuttallianus*	shaggy dwarf morning glory	4	4	1
SPLAINS-01	IPOLEP	*Ipomoea leptophylla*	bush morning glory	1	1	1
SPLAINS-01	KOCSCO	*Kochia scoparia*	kochia	1	1	1
SPLAINS-01	LAPOCC	*Lappula occidentalis*	flatspine sticktight	5	5	1
SPLAINS-01	LEPDEN	*Lepidium densiflorum*	common pepperweed	1	1	1
SPLAINS-01	OPUPOL	*Opuntia polyacantha*	plains pricklypear cactus	1	1	1
SPLAINS-01	PANCAP	*Panicum capillare*	annual witchgrass	1	1	1
SPLAINS-01	SALTRA	*Salsola tragus*	prickly russian thistle	16	10	1.6
SPLAINS-01	SOLROS	*Solanum rostratum*	buffalobur	1	1	1
SPLAINS-01	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	7	6	1.17
SPLAINS-01	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	11	9	1.22
SPLAINS-01	XANSPI	*Xanthisma spinulosum*	lacy tansyaster	1	1	1
UGRASS-LT04	ARIPUR1	*Aristida purpurea*	purple threeawn	22	8	2.75

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
UGRASS-LT04	ASTCRA	*Astragalus crassicarpus*	ground-plum	4	4	1
UGRASS-LT04	BOUDAC	*Bouteloua dactyloides*	buffalograss	1	1	1
UGRASS-LT04	BOUGRA	*Bouteloua gracilis*	blue grama	11	5	2.2
UGRASS-LT04	CALINV	*Callirhoe involucrata*	winecup	1	1	1
UGRASS-LT04	CHEWAT	*Chenopodium watsonii*	watson's goosefoot	1	1	1
UGRASS-LT04	CIRUND	*Cirsium undulatum*	wavyleaf thistle	1	1	1
UGRASS-LT04	CONARV	*Convolvulus arvensis*	field bindweed	3	3	1
UGRASS-LT04	DISSPI	*Distichlis spicata*	inland saltgrass	4	3	1.33
UGRASS-LT04	DYSPAP	*Dyssodia papposa*	fetid dogweed	1	1	1
UGRASS-LT04	ELYELY	*Elymus elymoides*	bottlebrush squirreltail	2	2	1
UGRASS-LT04	EUPDAV	*Euphorbia davidii*	davids spurge	1	1	1
UGRASS-LT04	EUPMAR	*Euphorbia marginata*	snow-on-the-mountain	1	1	1
UGRASS-LT04	HETVIL	*Heterotheca villosa*	hairy false goldenaster	4	4	1
UGRASS-LT04	KOCSCO	*Kochia scoparia*	kochia	8	8	1
UGRASS-LT04	LAPOCC	*Lappula occidentalis*	flatspine sticktight	2	2	1
UGRASS-LT04	LEPDEN	*Lepidium densiflorum*	common pepperweed	1	1	1
UGRASS-LT04	LYGJUN	*Lygodesmia juncea*	rush skeletonplant	3	3	1
UGRASS-LT04	PASSMI	*Pascopyrum smithii*	western wheatgrass	24	7	3.43
UGRASS-LT04	PHYLON	*Physalis longifolia*	longleaf groundcherry	3	3	1
UGRASS-LT04	POROLE	*Portulaca oleracea*	common purslane	1	1	1
UGRASS-LT04	PSOTEN	*Psoralidium tenuiflorum*	slimflower scurfpea	2	2	1
UGRASS-LT04	RATCOL	*Ratibida columnifera*	redspike mexican hat	1	1	1
UGRASS-LT04	SALTRA	*Salsola tragus*	prickly russian thistle	3	3	1
UGRASS-LT04	SCHPAN	*Schedonnardus paniculatus*	tumblegrass	1	1	1
UGRASS-LT04	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	7	7	1
UGRASS-LT04	SPOAIR	*Sporobolus airoides*	alkali sacaton	11	5	2.2
UGRASS-LT04	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	2	2	1
UGRASS-LT04	SYMERI	*Symphyotrichum ericoides*	white heath aster	3	3	1
USAGE-01	ARTFIL	*Artemisia filifolia*	sand sagebrush	10	8	1.25
USAGE-01	ARTLUD	*Artemisia ludoviciana*	louisiana sagewort	1	1	1
USAGE-01	BOUGRA	*Bouteloua gracilis*	blue grama	21	8	2.63
USAGE-01	CALLON	*Calamovilfa longifolia*	prairie sandreed	4	4	1
USAGE-01	CHEALB	*Chenopodium album*	common lambsquarters	11	10	1.1
USAGE-01	CONCAN	*Conyza canadensis*	canada horseweed	1	1	1
USAGE-01	CROTEX	*Croton texensis*	texas croton	1	1	1
USAGE-01	DESPIN	*Descurainia pinnata*	western tansymustard	2	2	1
USAGE-01	DISSPI	*Distichlis spicata*	inland saltgrass	1	1	1
USAGE-01	ERIANN2	*Eriogonum annuum*	annual buckwheat	3	3	1
USAGE-01	EVONUT	*Evolvulus nuttallianus*	shaggy dwarf morning glory	4	4	1
USAGE-01	HELPET	*Helianthus petiolaris*	prairie sunflower	4	4	1
USAGE-01	HESCOM	*Hesperostipa comata*	needle and thread	11	6	1.83
USAGE-01	KOCSCO	*Kochia scoparia*	kochia	2	2	1
USAGE-01	LAPOCC	*Lappula occidentalis*	flatspine sticktight	4	4	1
USAGE-01	MENDEC	*Mentzelia decapetala*	ten-petal blazingstar	3	3	1
USAGE-01	PASSMI	*Pascopyrum smithii*	western wheatgrass	4	3	1.33

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
USAGE-01	PLAPAT	*Plantago patagonica*	woolly plaintain	2	2	1
USAGE-01	SALTRA	*Salsola tragus*	prickly russian thistle	8	8	1
USAGE-01	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	1	1	1
USAGE-01	SPOAIR	*Sporobolus airoides*	alkali sacaton	10	3	3.33
USAGE-01	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	6	6	1
USAGE-F01	AMBPSI	*Ambrosia psilostachya*	western ragweed	13	9	1.44
USAGE-F01	ARIPUR1	*Aristida purpurea*	purple threeawn	3	3	1
USAGE-F01	ARTFIL	*Artemisia filifolia*	sand sagebrush	9	7	1.29
USAGE-F01	BOUGRA	*Bouteloua gracilis*	blue grama	15	7	2.14
USAGE-F01	CHEALB	*Chenopodium album*	common lambsquarters	13	8	1.63
USAGE-F01	CIRUND	*Cirsium undulatum*	wavyleaf thistle	1	1	1
USAGE-F01	DESPIN	*Descurainia pinnata*	western tansymustard	3	3	1
USAGE-F01	DISSPI	*Distichlis spicata*	inland saltgrass	4	1	4
USAGE-F01	ERIANN2	*Eriogonum annuum*	annual buckwheat	3	3	1
USAGE-F01	ESCVIV	*Escobaria vivipara*	spinystar	1	1	1
USAGE-F01	EVONUT	*Evolvulus nuttallianus*	shaggy dwarf morning glory	1	1	1
USAGE-F01	KOCSCO	*Kochia scoparia*	kochia	1	1	1
USAGE-F01	LYGJUN	*Lygodesmia juncea*	rush skeletonplant	2	2	1
USAGE-F01	OENSUF1	*Oenothera suffrutescens*	scarlet guara	1	1	1
USAGE-F01	OPUPHA	*Opuntia phaeacantha*	brwnspine pricklypear cactus	1	1	1
USAGE-F01	PACNEO	*Packera neomexicana*	new mexico groundsel	1	1	1
USAGE-F01	PASSMI	*Pascopyrum smithii*	western wheatgrass	1	1	1
USAGE-F01	PHYHIS	*Physalis hispida*	prairie groundcherry	1	1	1
USAGE-F01	PSOTEN	*Psoralidium tenuiflorum*	slimflower scurfpea	2	2	1
USAGE-F01	RAYANN	*Rayjacksonia annua*	viscid tansyaster	1	1	1
USAGE-F01	RUMALT	*Rumex altissimus*	pale dock	1	1	1
USAGE-F01	SALTRA	*Salsola tragus*	prickly russian thistle	4	4	1
USAGE-F01	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	9	9	1
USAGE-F01	SYMERI	*Symphyotrichum ericoides*	white heath aster	6	3	2
USAGE-F02	AF	*N/A*	annual forb	1	1	1
USAGE-F02	AMBPSI	*Ambrosia psilostachya*	western ragweed	2	2	1
USAGE-F02	APOCAN	*Apocynum cannabinum*	hemp dogbane	1	1	1
USAGE-F02	ARTFIL	*Artemisia filifolia*	sand sagebrush	18	9	2
USAGE-F02	BOUGRA	*Bouteloua gracilis*	blue grama	14	7	2
USAGE-F02	CALGIG	*Calamovilfa gigantea*	big sandreed	3	3	1
USAGE-F02	CHEALB	*Chenopodium album*	common lambsquarters	6	6	1
USAGE-F02	CHEWAT	*Chenopodium watsonii*	watson's goosefoot	4	3	1.33
USAGE-F02	CROTEX	*Croton texensis*	texas croton	1	1	1
USAGE-F02	DESPIN	*Descurainia pinnata*	western tansymustard	2	2	1
USAGE-F02	DISSPI	*Distichlis spicata*	inland saltgrass	10	7	1.43
USAGE-F02	ERIANN2	*Eriogonum annuum*	annual buckwheat	2	2	1
USAGE-F02	EUPDAV	*Euphorbia davidii*	davids spurge	1	1	1
USAGE-F02	EUPSER2	*Euphorbia serpyllifolia*	thyme-leaf sandmat	3	3	1
USAGE-F02	HESCOM	*Hesperostipa comata*	needle and thread	12	6	2
USAGE-F02	KOCSCO	*Kochia scoparia*	kochia	2	2	1

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
USAGE-F02	LYGJUN	*Lygodesmia juncea*	rush skeletonplant	2	2	1
USAGE-F02	MIRALB	*Mirabilis albida*	white four o'clock	2	2	1
USAGE-F02	MIRLIN	*Mirabilis linearis*	narrowleaf four o'clock	2	2	1
USAGE-F02	OPUPOL	*Opuntia polyacantha*	plains pricklypear cactus	2	2	1
USAGE-F02	PASSMI	*Pascopyrum smithii*	western wheatgrass	1	1	1
USAGE-F02	PHYHIS	*Physalis hispida*	prairie groundcherry	2	2	1
USAGE-F02	PHYLAN	*Phyla lanceolata*	lanceleaf frogfruit	1	1	1
USAGE-F02	SALTRA	*Salsola tragus*	prickly russian thistle	7	7	1
USAGE-F02	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	9	9	1
USAGE-F02	SPOAIR	*Sporobolus airoides*	alkali sacaton	11	3	3.67
USAGE-F02	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	6	6	1
USAGE-F02	SYMERI	*Symphyotrichum ericoides*	white heath aster	1	1	1
USAGE-LT01	ARTFIL	*Artemisia filifolia*	sand sagebrush	2	2	1
USAGE-LT01	BOUCUR	*Bouteloua curtipendula*	sideoats grama	2	2	1
USAGE-LT01	BOUDAC	*Bouteloua dactyloides*	buffalograss	5	3	1.67
USAGE-LT01	BOUGRA	*Bouteloua gracilis*	blue grama	41	10	4.1
USAGE-LT01	CHEALB	*Chenopodium album*	common lambsquarters	1	1	1
USAGE-LT01	CROTEX	*Croton texensis*	texas croton	1	1	1
USAGE-LT01	DALCAN	*Dalea candida*	slender white prairie clover	1	1	1
USAGE-LT01	DISSPI	*Distichlis spicata*	inland saltgrass	6	4	1.5
USAGE-LT01	EUPMIS	*Euphorbia missurica*	prairie sandmat	1	1	1
USAGE-LT01	EUPSER2	*Euphorbia serpyllifolia*	thyme-leaf sandmat	1	1	1
USAGE-LT01	GUTSAR	*Gutierrezia sarothrae*	broom snakeweed	3	3	1
USAGE-LT01	KOCSCO	*Kochia scoparia*	kochia	5	3	1.67
USAGE-LT01	LYGJUN	*Lygodesmia juncea*	rush skeletonplant	2	2	1
USAGE-LT01	OENSUF1	*Oenothera suffrutescens*	scarlet guara	1	1	1
USAGE-LT01	PSOTEN	*Psoralidium tenuiflorum*	slimflower scurfpea	3	3	1
USAGE-LT01	SALTRA	*Salsola tragus*	prickly russian thistle	3	3	1
USAGE-LT01	SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	3	3	1
USAGE-LT01	SPOCRY	*Sporobolus cryptandrus*	sand dropseed	9	7	1.29

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
U.S. Department of the Interior

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