USDA Natural Resources Conservation Service

Ecological site R081CY358TX
Deep Redland 29-35 PZ

Last updated: 9/19/2023
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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

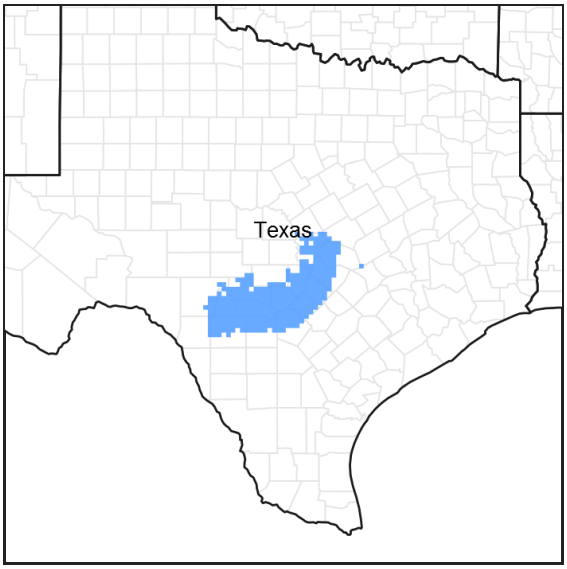


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 081C–Edwards Plateau, Eastern Part

This area represents the eastern part of the Edwards Plateau region. Limestone ridges and canyons and nearly level to gently sloping valley floors characterize the area. Elevation is 400 feet (120 meters) at the eastern end of the area and increases westward to 2,400 feet (730 meters) on ridges. This area is underlain primarily by limestones in the Glen Rose, Fort Terrett, and Edwards Formations of Cretaceous age. Quaternary alluvium is in river valleys.

Classification relationships

Major Land Resource Area (MLRA) and Land Resource Unit (LRU) (USDA-Natural Resources Conservation Service, 2006)
National Vegetation Classification/Shrubland & Grassland/2C Temperate & Boreal Shrubland and Grassland/M051 Great Plains Mixedgrass Prairie & Shrubland/ G133 Central Great Plains Mixedgrass Prairie Group.

Ecological site concept

The Deep Redlands have non-calcareous soils over limestone with a depth greater than 20- inches. Surface fragments 3 inches in size are less than 20 percent. The reference vegetation includes an oak savannah dominated

by tallgrasses and post oaks, along with numerous forbs and other oak species. Without fire or brush management, junipers and other woody species will likely increase on the site.

Associated sites

R081CY360TX	**Low Stony Hill 29-35 PZ** The Low Stony Hill ecological site is generally higher in the landscape and is the plateau above the Deep Redland ecological site with no post oak or blackjack oak.
R081CY355TX	**Adobe 29-35 PZ** The Adobe ecological site has sparser woody cover, much less production, more slope, and more caliche-type soils of a higher pH with no post oak or blackjack oak.

Similar sites

R081CY361TX	**Redland 29-35 PZ** The Redland ecological site has shallower soils.
R081CY357TX	**Clay Loam 29-35 PZ** The Clay Loam ecological site does not have post oak or blackjack oak. The soils are darker and higher in pH.

Table 1. Dominant plant species

Tree	(1) *Quercus stellata* (2) *Quercus fusiformis*
Shrub	(1) *Quercus marilandica*
Herbaceous	(1) *Schizachyrium scoparium*

Physiographic features

This site is classified as an upland. Slope gradients are mainly less than 3 percent and range from 0 to 8 percent. It is presumed that this site was formed in residuum from weathered limestone. Elevation of this site ranges from 600 to 2400 feet above mean sea level. This site will receive runoff from Adobe and Low Stony Hills ecological sites that normally occur along the site's boundary.

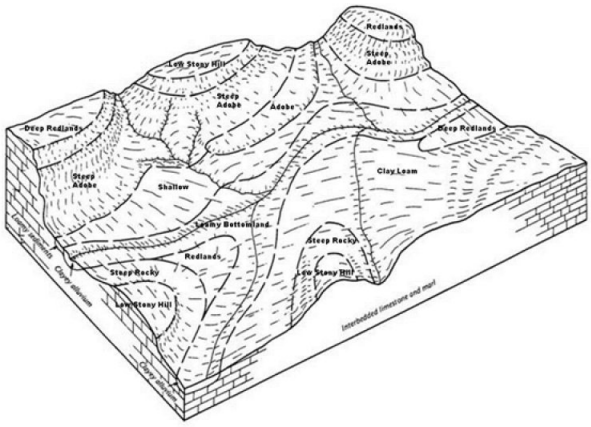


Figure 2. Deep Redland 081CY358TX

Table 2. Representative physiographic features

Landforms	(1) Plateau > Plain (2) Plateau > Hillslope (3) Plateau > Ridge
Runoff class	High to very high

Flooding frequency	None
Ponding frequency	None
Elevation	600–2,400 ft
Slope	0–8%
Aspect	Aspect is not a significant factor

Climatic features

The climate is humid subtropical and is characterized by hot summers and relatively mild winters. The average first frost should occur around November 15 and the last freeze of the season should occur around March 19.

The average relative humidity in mid-afternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible during the summer and 50 percent in winter. The prevailing wind direction is southeast.

Drought is calculated as 75% below average rainfall. It should be noted that timing of rainfall may be more significant than average rainfall.

Approximately two-thirds of annual rainfall occurs during the April to September period. Rainfall during this period generally falls during thunderstorms, and fairly large amount of rain may fall in a short time. Hurricanes provide another source of extremely high rains in a short time. A review of the rainfall records suggest that rainfall is below “normal” at least 60 percent of the time. Therefore, the erratic nature of the rainfall should be considered when developing any land management plans.

The impact of droughts in the Edwards Plateau cannot be under-estimated. Not only are droughts devastating to the land but also to those that manage the land. Droughts occur roughly every 20 years but not always. A severe drought in 2012 coupled with extreme heat resulted in a die off of juniper over millions of acres as well as other native plants.

Table 3. Representative climatic features

Frost-free period (characteristic range)	210-260 days
Freeze-free period (characteristic range)	227-269 days
Precipitation total (characteristic range)	32-37 in
Frost-free period (actual range)	187-260 days
Freeze-free period (actual range)	224-332 days
Precipitation total (actual range)	31-37 in
Frost-free period (average)	235 days
Freeze-free period (average)	257 days
Precipitation total (average)	34 in

Climate stations used

- (1) MEDINA 1NE [USC00415742], Medina, TX
- (2) SAN ANTONIO/SEAWORLD [USC00418169], San Antonio, TX
- (3) KERRVILLE 3 NNE [USC00414782], Kerrville, TX
- (4) BLANCO [USC00410832], Blanco, TX
- (5) CANYON DAM [USC00411429], Canyon Lake, TX
- (6) BURNET MUNI AP [USW00003999], Burnet, TX
- (7) AUSTIN GREAT HILLS [USC00410433], Austin, TX
- (8) GEORGETOWN LAKE [USC00413507], Georgetown, TX
- (9) PRADE RCH [USC00417232], Leakey, TX

Influencing water features

This being an upland site, it is not influenced by water from a wetland or stream.

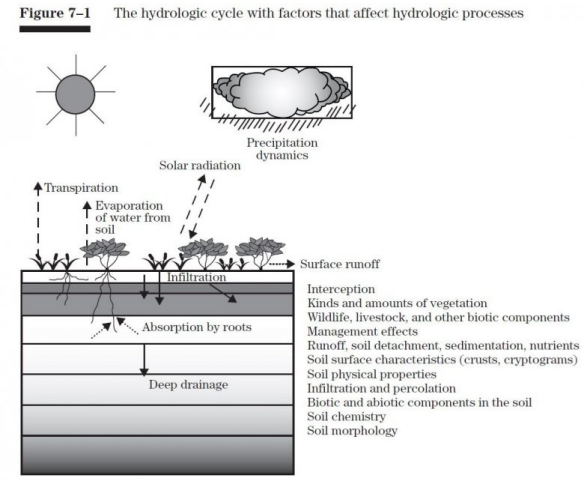


Figure 9.

Soil features

In a representative profile for the Deep Redland ecological site, the soils are reddish brown, moderately deep, non-calcareous clays, clay loams or loams. They are underlain by slightly fractured indurated limestone bedrock at depths of 20 to 40 inches. Plant roots penetrate the crevices, which are usually filled with reddish brown clay. Limestone fragments, cherts, cobbles and stones sometimes occur on the surface and may make up as much as 15 percent of the soil by volume. When dry, the soils crack and take in water rapidly. When wet, the cracks close, and the soils become sticky and plastic and take in water very slowly. Light showers are ineffective on the site, which favors the growth of deep-rooted perennial plants. When plant residues are inadequate, soil condition deteriorates and heavy surface crusts develop. In this condition water intake is very slow, runoff is rapid, erosion is a hazard, and grass recovery is slow. The mineral content and reaction of these soils enable the site to produce highly nutritious forage. In association with other sites, Deep Redland is usually the preferred grazing area. These sites occur on more stable hillslopes on dissected plateaus.

Due to the scale of mapping, there are inclusions of minor components of other soils within these mapping units. Before performing any inventories, conduct a field evaluation to insure the soils are correct for the site.

The representative soil series associated with the Deep Redland ecological site are Anhalt, Crawford, and Spires.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone
Surface texture	(1) Clay (2) Silty clay loam (3) Loam
Drainage class	Well drained
Permeability class	Very slow
Depth to restrictive layer	20–40 in
Soil depth	20–40 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–2%
Available water capacity (0-40in)	1.8–7 in

Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	5.6–8.4
Subsurface fragment volume <=3" (4-40in)	0–15%
Subsurface fragment volume >3" (4-40in)	0–5%

Ecological dynamics

The information contained in the State and Transition Diagram (STD) and the Ecological Site Description was developed using archeological and historical data, professional experience, and scientific studies. The information presented is representative of a very complex set of plant communities. Not all scenarios or plants are included. Key indicator plants, animals and ecological processes are described to inform land management decisions.

The reference plant community, which was a post oak (*Quercus stellata*), Texas live oak (*Quercus fusiformis*), blackjack oak (*Quercus marilandica*), savannah, included little bluestem, (*Schizachyrium scoparium*) big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and eastern gamagrass (*Tripsacum dactyloides*). This is a very fertile and productive site. Because of the soil chemistry of this site with its neutral to sometimes slightly acidic pH, it is usually a preferred grazing site.

Natural plant mortality is very low with the major species producing seeds and vegetative structure each year in normal years. Litter cover is 100 percent. Physical soil crust is largely absent.

A study of early photographs of this region reveals that today these sites are much denser with woody cover and less covered with grasslike vegetation. Early accounts consistently describe this region as a vast expanse of hills covered with "cedar" from San Antonio to Austin. Accounts also describe an abundance of clean, flowing water and abundant wildlife. These accounts seem to describe heavy wooded areas in mosaic patterns occurring along the highs and lows of the landscape.

The plant communities of this site are dynamic and vary in relation to grazing, fire and rainfall. Studies of the pre-European vegetation of the general area suggested 47 percent of the area was wooded (Wills, 2006). Historical records are not specific on the Deep Redland site but do reflect area observations. From the Teran expedition in 1691, “great quantities of buffaloes” were noted in the area. By 1840 the Bonnell expedition reflected that “buffalo rarely range so far to the south” (Inglis, 1964). Another example is an early settler, Arnold Gugger, who wrote in his journal about the mid to late 1800s in the Helotes, Texas area, “in those days buffaloes were in droves by the hundreds…..and antelopes were three to four hundred in a bunch….and deer and turkeys at any amount” (Massey, 2009). A study of early photographs of this region reveals that today, these sites are much denser with woody cover and less covered with grasslike vegetation.

Many research studies document the interaction of bison grazing and fire (Fuhlendorf, et al, 2008.). Bison would come into an area, graze it down, leave and then not come back for many months or even years. Many times this grazing scheme by buffalo was high impact and followed fire patterns and available natural water. This usually long deferment period allowed the taller grasses and forbs to recover from the high impact bison grazing. This relationship created a diverse landscape both in structure and composition.

Historical fire frequencies for the region are suggested to be 13 to 25 years (Frost, 1998). When fires did occur, they were set either by Native Americans or by lighting. Woody plant control would vary in accordance with the intensity and severity of the fire encountered, which resulted in a mosaic of vegetation types within the same site.

Ashe juniper (*Juniperus ashei*) will increase regardless of grazing. Juniper will establish with grazing and without

unless goats are utilized. Goats and possibly sheep will eat young juniper and when properly used, are an effective tool to maintain juniper (Taylor, 1997; Anderson, et al., 2013). The main role of excessive grazing relative to juniper is the removal of the fine fuel needed to carry an effective burn.

Ashe juniper, because of its dense low growing foliage, has the ability to retard grass and forb growth. Grass and forb growth can become non-existent under dense juniper canopies. Many times there is a resurgence of the better grasses such as little bluestem when Ashe juniper is controlled and followed by proper grazing management. Seeds and dormant rootstocks of many plant species are contained in the leaf mulch and duff under the junipers.

Currently, goats, white-tailed deer, sheep, and exotic animals are the primary large herbivores. At settlement, large numbers of deer occurred, but as human populations increased (with unregulated harvest) their numbers declined substantially. Eventually, laws and restrictions on deer harvest were put in place which assisted in the recovery of the species. Females were not harvested for several decades following the implementation of hunting laws, which allowed population booms. In addition, suppression of fire favored woody plants which provided additional browse and cover for the deer. Because of their impacts on livestock production, large predators such as red wolves (Canis rufus), mountain lions (Felis concolor), black bears (Ursus americanus) and eventually coyotes (Canis latrins) were reduced in numbers or eliminated (Schmidly, 2002).

The screwworm (Cochilomyia hominivorax) was essentially eradicated by the mid-1960s, and while this was immensely helpful to the livestock industry, this removed a significant control on deer populations (Teer, Thomas, and Walker, 1965; Bushland, 1985).

Progressive management of the deer herd, because of their economic importance through lease hunting, has the objective of improving individual deer quality and improving habitat. Managed harvest based on numbers, sex ratios, condition, and monitoring of habitat quality has been effective on individual properties. However, across the Edwards Plateau, excess numbers still exist which may lead to habitat degradation and significant die-offs during stress periods such as extended droughts.

The Edwards Plateau is home to a variety of exotic ungulates, mostly introduced for hunting (Schmidly, 2002). These animals are important sources of income to some landowners, but as with the white-tailed deer, their populations must be managed to prevent degradation of the habitat for themselves as well as for the diversity of native wildlife in the area. Many other species of medium and small-sized mammals, birds, and insects can have significant influences on the plant communities in terms of pollination, herbivory, seed dispersal, and creation of local disturbance patches, all of which contribute to the plant species diversity.

The plants and topography aided in increasing the infiltration of rainfall into the moderately slowly permeable soil. Any loss of soil organic matter and plant cover has a negative effect on infiltration. More rainfall is directed to overland flow, which causes increased soil erosion and flooding. Soils are also more prone to drought stress since organic matter acts like a sponge aiding in moisture retention for plant growth. Mulch buildup under the Ashe juniper canopy, following brush management and incorporation into the soil, can have a positive effect on increasing infiltration.

This site contains a large diversity of plants and this document does not attempt to cover them all. The intent of this document is to describe ecological processes on representative plants.

European settlement occurred in the mid to late 1800s (Raunick, 2007). This time period also coincided with a stoppage of fire. It was during this time that large-scale fencing was initiated to help the introduction of livestock. Predators were also reduced to protect livestock. In many cases sheep and goats heavily utilized the site. Low successional, unpalatable grasses, forbs and shrubs have taken the place of the more desirable plant species. Non-preferred browse, such as juniper, fared well at the expense of the palatable browse. Juniper is undoubtedly the dominant woody plant over most of the site today.

During the early 1900s, land managers recognized the soil's ability to produce annual field crops for added food, forage, and hay. Many of the Deep Redland Sites were put to the plow removing all of the historic species. As land managers decisions changed in the 1970""s, many of the fields were reintroduced with non-native grasses such as bermudagrass (*Cynodon dactylon*), yellow bluestems (Bothriochloa spp.), and kleingrass (*Panicum coloratum*). These practices are still used today.

Plant Communities and Transitional Pathways (diagram):

A State and Transition Model for the Deep Redland Ecological Site (R081CY358TX) is depicted in this report. Descriptions of each state, transition, plant community, and pathway follow the model. Experts base this model on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

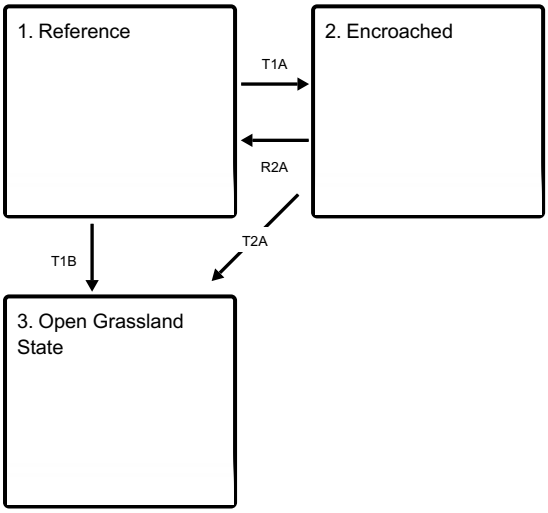
Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal but can be. Other vegetative states may be desired plant communities as long as the Range Health assessments are in the moderate and above category. The biological processes on this site are complex. Therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by weight and percent canopy cover are described as are other metrics. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs). Canopy cover can drive the transitions between communities and states because of the influence of shade and interception of rainfall. Species composition by dry weight is used for describing the herbaceous community and the community as a whole. Woody species are included in species composition for the site. Calculating the similarity index requires the use of species composition by dry weight.

The following diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown in the diagram. This information is intended to show what might happen in a given set of circumstances. It does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

State and transition model

Ecosystem states



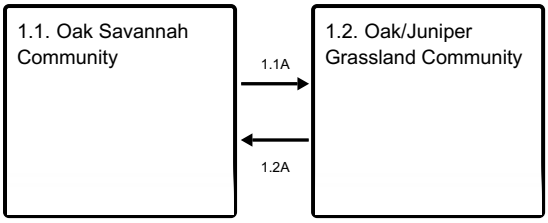
T1A - Absence of disturbance and natural regeneration overtime

T1B - Removal of woody species, extensive soil disturbance, followed by seeding

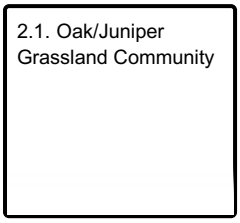
R2A - Reintroduction of natural disturbance regimes

T2A - Removal of woody species, extensive soil disturbance, followed by seeding

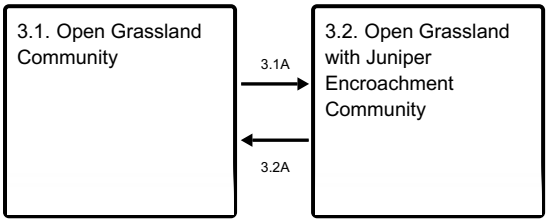
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference

The reference state is considered to be representative of the natural range of variability under pre-Euro settlement conditions. It is characterized by a savannah composed of tallgrasses and scattered post oaks. Community phase changes are primarily driven by wildfire, grazing, and climatic fluctuations.

Dominant plant species

- post oak (*Quercus stellata*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- big bluestem (*Andropogon gerardii*), grass

Community 1.1
Oak Savannah Community

Figure 10. Excellent example of the reference plant community

Figure 11. Oak Savannah community with tall grasses following a hard drought.

The Oak Savannah Community (1.1) is the interpretive plant community for this. The historic plant community is a fire/grazing climax savannah composed of tall grasses. The overstory shades 10 to 20 percent of the site and consists primarily of post oak, but may include Bigelow oak (*Quercus buckleyi*), Texas red oak (*Quercus texana*), Texas live oak (*Quercus fusiformis*), blackjack oak (*Quercus marilandica*), and several associated species. The pos oak and blackjack oak are signature key indicators of the Deep Redland site. Occasionally however there may only be Texas live oak. The role of fire and grazing was to keep sunlight energy flowing through the deep-rooted trees and grasses, accelerate the mineral and nutrient cycle and to capture the optimum amount of rainfall. The removal or alteration of these ecological disturbances can trigger the plant community to change. The total removal of grazing animals may, in fact, accelerate this change. Juniper is added to the site via droppings from perching birds and small mammals that eat the seeds. Ashe juniper, which is a non-sprouting woody plant easily controlled by fire, and other woody species will increase without fire or some form of brush management. Once Ashe juniper encroachment can be easily controlled with prescribed fire until the plants reach exceeds about 6 feet in height, fire options become limited. Without intervention, the Ashe juniper will continue to increase and move towards the Oak/Juniper Grassland plant community. This may occur in as little as five years.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1950	2975	3575
Tree	600	860	1100
Forb	300	430	550
Shrub/Vine	150	275	430
Total	**3000**	**4540**	**5655**

Table 6. Ground cover

Tree foliar cover	2-3%
Shrub/vine/liana foliar cover	1-2%
Grass/grasslike foliar cover	15-20%
Forb foliar cover	0-2%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%

Water	0%
Bare ground	0-10%

Table 7. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	–
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	–
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	–
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	–
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	–
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	5-15 per acre
Tree snag count** (hard***)	

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 8. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	1-3%	0-1%
>0.5 <= 1	–	1-3%	3-5%	1-3%
>1 <= 2	–	5-8%	10-15%	3-10%
>2 <= 4.5	–	5-10%	50-60%	–
>4.5 <= 13	–	–	–	–
>13 <= 40	5-20%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Figure 13. Plant community growth curve (percent production by month). TX3760, Warm Season Native Grasses. Native warm season grasses on rangeland with scattered oaks/junipers..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	5	13	22	15	5	3	15	7	5	4

Community 1.2
Oak/Juniper Grassland Community

Figure 14. Young juniper establishing underneath the oak trees.

This community still exhibits an oak savannah community, however, because of the elimination of fire and/or brush management, woody species begin to invade or increase on the site. This site had a natural variation that probably included some juniper. However, historic fires precluded it from achieving anything other than an occasional tree. The dominant grass species for this plant community are little bluestem, Indiangrass, and sideoats grama (*Bouteloua curtipendula*). The major species to invade this site is Ashe juniper. Juniper in this plant community is still about 6 feet tall with approximately 5 percent canopy cover. There are sufficient grasses to provide fine fuel loading for a prescribed burn. Juniper will increase on this site regardless of grazing. The best option for using animals to control cedar is the prudent and timely grazing/browsing with goats and/or possibly sheep (Taylor, 1997; Anderson, et al., 2013). If the proper vegetation management decisions are not performed, the site will transition to the Oak/Juniper Grassland State (2) in 10 to 15 years and a significant, high energy intervention will be needed for restoration.

Resilience management. By implementing vegetative management such as prescribed burning and prescribed grazing, the land manager can shift the plant community towards the Oak Savannah with minimum labor and expense. The sun's energy being captured by the juniper can then be redirected back to the original plants. Mineral cycling, nutrient cycling and the water cycle are restored as well. A burn or some type of brush management will be needed on a 5- to 10-year return depending upon the size of the juniper.

Table 9. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1650	2365	2750
Tree	750	1075	1250
Forb	300	430	500
Shrub/Vine	300	430	500
Total	**3000**	**4300**	**5000**

Figure 16. Plant community growth curve (percent production by month). TX3760, Warm Season Native Grasses. Native warm season grasses on rangeland with scattered oaks/junipers..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	5	13	22	15	5	3	15	7	5	4

Pathway 1.1A
Community 1.1 to 1.2

Oak Savannah Community

Oak/Juniper Grassland Community

A shift in the composition of the plant community is primarily driven by the lack of managing woody plants, juniper in particular. Juniper and other woody species are introduced from the site primarily through wildlife fecal deposits. Grazing that removes fuel loading for fire is a contributing factor. However juniper can increase regardless of grazing pressure unless possibly sheep and goats are utilized.

Pathway 1.2A
Community 1.2 to 1.1

Oak/Juniper Grassland Community

Oak Savannah Community

This recovery pathway consist of some method of brush management such as fire, mechanical or hand cutting or targeted grazing with goats and/or possibly sheep. Prescribed grazing is essential.

State 2
Encroached

This state is characterized by increased density and cover of juniper. Ecological processes and site resources are being controlled by juniper and other woody plants. Sunlight energy is captured in juniper and woody component of the community. Interception of rainfall in the foliage of the juniper reduces infiltration and soil moisture storage . As much as 20 percent of the annual rainfall is entrapped (Thurow, 1994).

Dominant plant species

- Ashe's juniper (*Juniperus ashei*), tree
- honey mesquite (*Prosopis glandulosa*), shrub

Community 2.1
Oak/Juniper Grassland Community

Figure 17. The Oak/Juniper Grassland (2.1) community after a burn.

Figure 18. The Oak/Juniper Grassland Community (2.1) with mature juniper.

This community has crossed a threshold from the Oak Savannah State (1). The major woody species to invade is Ashe juniper. Other woody species to commonly invade/increase this site are honey mesquite (*Prosopis glandulosa*), Texas persimmon (*Diospyros texana*), algerita Mahonia trifoliata), elbowbush (*Forestiera pubescens*), lotebush (*Ziziphus obtusifolia*), Bigelow oak (*Quercus sinuata*), and prickly pear (Opuntia spp.). This site will exhibit Ashe juniper 8 to 12 feet tall with 10 to 30 percent canopies. Foliar cover ranges from 5 to 30 percent. The juniper plants are between 5 and 20 years old. Grasslike vegetation is significantly reduced because of the competition that Ashe juniper and other brush species present regarding sunlight, nutrients and moisture. The dominant grass-like species for this plant community are meadow dropseed (*Sporobolus compositus*), silver bluestem (*Bothriochloa saccharoides*), a small amount of sideoats grama, little bluestem, and an occasional Indiangrass. Cool season plant such as Texas wintergrass (*Nassella leucotricha*) and cedar sedge (*Carex planostachys*) occur in the understory. The recovery from an Oak/Juniper Grassland Community (2.1) back to the reference community is still possible but it will involve a considerable investment of time and expense. Implementation of brush management programs involving heavy equipment and/or hand labor makes much higher treatment cost probable. The juniper will only get larger and taller unless intervention is done to prevent it. It is likely that any fires that could burn here under this condition would be wildfires that would also damage the oak community. If left alone for about 20 years, the juniper will attain heights of over 20 feet and crown canopies exceeding 30 percent. At this point the juniper is a threat to the oaks.

Table 10. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Tree	1500	2150	2500
Grass/Grasslike	600	860	1000
Shrub/Vine	600	860	1000
Forb	300	430	500
Total	**3000**	**4300**	**5000**

Table 11. Ground cover

Tree foliar cover	5-30%
Shrub/vine/liana foliar cover	3-5%
Grass/grasslike foliar cover	2-15%
Forb foliar cover	2-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	90-100%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0-1%

Bedrock	0%
Water	0%
Bare ground	0-10%

Table 12. Soil surface cover

Tree basal cover	2-5%
Shrub/vine/liana basal cover	1-2%
Grass/grasslike basal cover	15-25%
Forb basal cover	1-2%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 13. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	–
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	–
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	–
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	–
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	–
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	25-35 per acre
Tree snag count** (hard***)	

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 14. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	1-3%	0-1%
>0.5 <= 1	–	1-3%	3-5%	1-3%
>1 <= 2	–	5-8%	10-15%	3-10%
>2 <= 4.5	5-15%	5-10%	50-60%	–
>4.5 <= 13	10-25%	–	–	–
>13 <= 40	5-30%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Figure 20. Plant community growth curve (percent production by month). TX3762, Oak/Juniper Grassland. "Grassland with warm season grasses, oaks, and juniper.".

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	5	8	13	18	12	5	3	12	10	7	4

State 3
Open Grassland State

This state is characterized by extensive soil disturbance, followed by reseeding with native or exotic species or a combination. Species diversity and site resilience has been reduced. Depending on previous land use soil structure may be deteriorated, many soil organisms are missing and the site is at-risk of soil erosion.

Dominant plant species

- Johnsongrass (*Sorghum halepense*), other herbaceous
- beardgrass (*Bothriochloa*), other herbaceous
- Bermudagrass (*Cynodon dactylon*), other herbaceous

Community 3.1
Open Grassland Community

Figure 21. Foreground shows the site after replanting, following its use as cropland.

This community is former cropland that has been reseeded. Depending upon the management goals, the site can be seeded to native or exotic species or a combination. Much of the species diversity and site integrity has been lost when compared to the reference plant community. Depending upon the length of plowing and the intensity of the plowing, the soil health and structure may be deteriorated. Many of the original soil organisms are missing and soil

erosion may have taken place. Soil compaction is usually a problem to be dealt with. This fact makes it difficult to restore completely to the reference plant community. Through the re-introduction of fire and prescribed grazing, plus reseeding of native forbs and grasses, this site can be restored to something resembling the historic plant community as far as the grassland component. It may take many years for natural processes within the soil to restore the oak species. Utilizing native plants in the re-seeded source will greatly benefit wildlife species such as deer, turkey, quail, and other birds. This open grassland community may also represent a community of annual and/or perennial seeded species which are non-native and which may occur as monoculture communities. These monoculture type communities may be too dense for wildlife. These communities are typically not very diverse. Typically these include naturalized species such as King Ranch bluestem, bermudagrass, Johnsongrass (*Sorghum halepense*), silky bluestem (*Dichanthium sericeum*), kleingrass, and many others. In many cases, hardly any native grasses can be found. There has been a dramatic reduction in the native forb and legume diversity. Total production for this site may be similar to the productive potential of this site in reference condition except the majority of the plant community is grasses.

Table 15. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	2700	3870	4500
Shrub/Vine	150	215	250
Forb	150	215	250
Tree	0	0	0
Total	**3000**	**4300**	**5000**

Table 16. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-1%
Grass/grasslike foliar cover	15-40%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	90-100%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0-1%
Bedrock	0%
Water	0%
Bare ground	0-10%

Table 17. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	15-20%
Forb basal cover	1-2%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%

Bedrock	0%
Water	0%
Bare ground	0%

Table 18. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	1-3%	0-1%
>0.5 <= 1	–	0-3%	3-5%	1-3%
>1 <= 2	–	–	20-50%	3-10%
>2 <= 4.5	–	–	60-100%	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Figure 23. Plant community growth curve (percent production by month). TX3764, Open Grassland. Warm season grasses with minor cool season influence on open grassland..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	5	15	25	20	7	5	13	5	2	1

Community 3.2
Open Grassland with Juniper Encroachment Community

Figure 24. Site re-seeded to exotic grasses following use as cropland.

This community is reseeded open grassland which has an encroachment of woody species. The introduction of integrated brush management, prescribed burning and prescribed grazing this site will successfully shift back towards the Open Grassland Community and remain productive. If brush management alternatives are not implemented in a timely manner, this site will become infested with woody species. In as little as 20 years, the brush will be utilizing most of the sunlight and moisture stored in the soil. In addition, rainfall entrapment will deteriorate the hydrologic cycle so that less moisture is absorbed into the rooting zone. Forage productivity will decline accordingly as grazeable acreage decreases.

Table 19. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Tree	1500	2150	2500
Grass/Grasslike	1200	1720	2000
Shrub/Vine	150	215	250
Forb	150	215	250
Total	**3000**	**4300**	**5000**

Figure 26. Plant community growth curve (percent production by month). TX3764, Open Grassland. Warm season grasses with minor cool season influence on open grassland..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	5	15	25	20	7	5	13	5	2	1

Pathway 3.1A
Community 3.1 to 3.2

Open Grassland Community

Open Grassland with Juniper Encroachment Community

Without fire or brush management, this site may shift to community 3.2.

Pathway 3.2A
Community 3.2 to 3.1

Open Grassland with Juniper Encroachment Community

Open Grassland Community

With prescribed fire, brush management, and proper grazing management, the site may shift back to community 3.1.

Transition T1A
State 1 to 2

A transition occurs because of a lack of brush management with mechanical means, with fire or with targeted goat/possibly sheep grazing. Grazing deferment alone will not halt the increase of woody species.

Transition T1B
State 1 to 3

Land clearing of the woody species and replanting with grasses represent this transition. Recovery to the Oak Savannah State is very doubtful, especially if exotic plants are utilized. Even though the plants are exotic, many times their hydrologic function is similar to the original native plants excepting the oak species.

Restoration pathway R2A
State 2 to 1

The restoration pathway includes some form of brush management. Prescribed burning will also help and prescribed grazing will be essential. In some cases of severe long-term overharvesting of the desired plants, replanting may be necessary.

Transition T2A
State 2 to 3

Land clearing of the woody species and replanting with grasses represent this transition. Recovery to the Oak Savannah State is very doubtful, especially if exotic plants are utilized. Even though the plants are exotic, many times their hydrologic function is similar to the original native plants excepting the oak species.

Additional community tables

Table 20. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall grass**			800–1800	
	little bluestem	SCSC	*Schizachyrium scoparium*	800–1200	–
2	**Tallgrasses**			1000–1200	
	big bluestem	ANGE	*Andropogon gerardii*	500–1000	–
	Indiangrass	SONU2	*Sorghastrum nutans*	500–1000	–
	eastern gamagrass	TRDA3	*Tripsacum dactyloides*	0–800	–
	switchgrass	PAVI2	*Panicum virgatum*	0–300	–
3	**Midgrasses**			400–600	
	sideoats grama	BOCU	*Bouteloua curtipendula*	400–500	–
	plains lovegrass	ERIN	*Eragrostis intermedia*	100–200	–
	Texas cupgrass	ERSE5	*Eriochloa sericea*	100–200	–
	vine mesquite	PAOB	*Panicum obtusum*	100–200	–
	purpletop tridens	TRFL2	*Tridens flavus*	0–100	–
4	**Midgrasses**			40–200	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	50–100	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	40–100	–
	composite dropseed	SPCO16	*Sporobolus compositus*	50–100	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	50–100	–
	white tridens	TRAL2	*Tridens albescens*	25–100	–
5	**Shortgrasses**			40–200	
	threeawn	ARIST	*Aristida*	25–100	–
	buffalograss	BODA2	*Bouteloua dactyloides*	10–100	–
	fall witchgrass	DICO6	*Digitaria cognata*	10–100	–
	curly-mesquite	HIBE	*Hilaria belangeri*	10–100	–
6	**Cool Season Grasses**			200–400	
	Canada wildrye	ELCA4	*Elymus canadensis*	50–200	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	100–200	–
	cedar sedge	CAPL3	*Carex planostachys*	50–100	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	50–100	–
Forb					

Forb					
7	**Forbs**			40–430	
	awnless bushsunflower	SICA7	*Simsia calva*	25–150	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	25–150	–
	dotted blazing star	LIPU	*Liatris punctata*	25–100	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	25–100	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	25–100	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	25–100	–
	prairie clover	DALEA	*Dalea*	25–100	–
	bundleflower	DESMA	*Desmanthus*	25–100	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	25–100	–
	fuzzybean	STROP	*Strophostyles*	25–75	–
	ticktrefoil	DESMO	*Desmodium*	25–75	–
	mallow	MALVA	*Malva*	25–75	–
	smartweed leaf-flower	PHPO3	*Phyllanthus polygonoides*	25–75	–
	scurfpea	PSORA2	*Psoralidium*	25–75	–
	snoutbean	RHYNC2	*Rhynchosia*	25–75	–
	wild petunia	RUELL	*Ruellia*	25–75	–
Shrub/Vine					
8	**Shrubs**			50–430	
	bully	SIDER2	*Sideroxylon*	50–200	–
	prairie sumac	RHLA3	*Rhus lanceolata*	50–200	–
	greenbrier	SMILA2	*Smilax*	50–150	–
	stretchberry	FOPU2	*Forestiera pubescens*	50–150	–
	algerita	MATR3	*Mahonia trifoliolata*	50–100	–
	jointfir	EPHED	*Ephedra*	0–100	–
	skunkbush sumac	RHTR	*Rhus trilobata*	50–100	–
	evergreen sumac	RHVI3	*Rhus virens*	0–100	–
	eastern redbud	CECA4	*Cercis canadensis*	50–100	–
	snailseed	CODI	*Cocculus diversifolius*	25–75	–
	Texas persimmon	DITE3	*Diospyros texana*	10–75	–
	Virginia creeper	PAQU2	*Parthenocissus quinquefolia*	25–75	–
	grape	VITIS	*Vitis*	25–75	–
	desert-thorn	LYCIU	*Lycium*	0–50	–
Tree					
9	**Tree**			40–200	
	Texas live oak	QUFU	*Quercus fusiformis*	0–200	–
	blackjack oak	QUMA3	*Quercus marilandica*	0–200	–
	post oak	QUST	*Quercus stellata*	0–200	–
	Texas red oak	QUBU2	*Quercus buckleyi*	50–150	–
	Nuttall oak	QUTE	*Quercus texana*	0–100	–
	hackberry	CELTI	*Celtis*	50–100	–

Animal community

This site is used for the production of domestic livestock and to provide habitat for native wildlife and certain species of exotic wildlife. Cow-calf operations are the primary livestock enterprise although stocker cattle are also grazed. Sheep and goats were formerly raised in large numbers and are still present in reduced numbers. Sustainable stocking rates have declined drastically over the past 100 years due to the deterioration of the historic plant community. Initial starting stocking rates will be determined with the landowner or decision maker. An assessment of vegetation is needed to determine stocking rates. Calculations used to determine an initial starting stocking rate will be based on forage production and on grazeable acres.

A large diversity of wildlife is native to this site. In the historic plant community, large migrating herds of bison, resident herds of pronghorn and large numbers of lesser prairie chickens were the more dominant species. With the demise of these species and the changes in the plant community, the kinds of wildlife have changed.

With the eradication of the screwworm fly, the increase in woody vegetation, and insufficient natural predation, white-tailed deer numbers have increased drastically and are often in excess of natural carrying capacity. Where deer numbers are excessive, overbrowsing and overuse of preferred forbs causes deterioration of the plant community. Progressive management of deer populations through hunting can keep populations in balance and provide an economically important ranching enterprise. Achieving a balance between woodland and more open plant communities on this site is an important key to deer management. Competition among deer, sheep and goats can be an important consideration in livestock and wildlife management and can cause damage to preferred native vegetation.

Smaller mammals include many kinds of rodents, jackrabbit, cottontail rabbit, raccoon, skunks, possum, and armadillo. Mammalian predators include coyote, red fox, gray fox, bobcat, and mountain lion. Many species of snakes and lizards are native to the site.

Many species of birds are found on this site including game birds, songbirds, and birds of prey. Major game birds that are economically important are Rio Grande turkey, bobwhite quail, and mourning dove. Turkey prefer plant communities with substantial amounts of shrubs and trees interspersed with grassland. Quail prefer plant communities with a combination of low shrubs, bunch grass, bare ground and low successional forbs. The different species of songbirds vary in their habitat preferences. In general, a habitat that provides a large variety of grasses, forbs, shrubs, vines and trees and a complex of grassland, savannah, shrubland, and woodland will support a good variety and abundance of songbirds. Birds of prey are important to keep the numbers of rodents, rabbits, and snakes in balance. The different plant communities of the site will sustain different species of raptors.

Various kinds of exotic wildlife have been introduced on the site including axis, sika, fallow and red deer, aoudad sheep, and blackbuck antelope. Their numbers should be managed in the same manner as livestock and white-tailed deer to prevent damage to the plant community. Feral hogs are present and can cause damage when their numbers are not managed.

Plant Preference by Animal Kind:
This rating system provides general guidance as to animal forage preference for plant species. It also indicates possible competition and diet overlap between kinds of herbivores. Grazing preference changes from time to time, especially between seasons, and between animal kinds and classes. An animal’s preference or avoidance of certain plants is learned over time through grazing experience and maternal learning (http://extension.usu.edu/behave/Grazing). Preference does not necessarily reflect the ecological status of the plant within the plant community. For wildlife, plant preferences for food are rated. Refer to detailed habitat guides for a more complete description of a species habitat needs.

Legend: P=Preferred D=Desirable U=Undesirable N=Not Consumed T=Toxic X=Used, but the degree of utilization unknown
Preferred – Percentage of plant in animal diet is greater than it occurs on the land
Desirable – Percentage of plant in animal diet is similar to the percentage composition on the land
Undesirable – Percentage of plant in animal diet is less than it occurs on the land
Not Consumed – Plant would not be eaten under normal conditions. It is only consumed when other forages not available.

Toxic – Rare occurrence in diet and, if consumed in any tangible amounts results in death or severe illness in the animal.

Hydrological functions

The water cycle on this site functions according to the existing plant community and the management of that plant community. The water cycle is most functional when the site is dominated by tall bunchgrass and the oak savannah. Rapid rainfall infiltration, high soil organic matter, good soil structure, and good porosity are present with a good cover of bunchgrass. When dry, the soils crack and take water in readily. When wet, the cracks close and the soil becomes sticky, and plastic taking water in slowly. Light showers are ineffective to this site. Quality of surface runoff will be high and erosion and sedimentation rates will be low. With high rates of infiltration and periods of heavy rainfall, some water will move below the root zone of grasses into the fractures in the limestone. As this water moves downward it contributes to the recharge of aquifers.

When heavy grazing causes loss or reduction of bunchgrass and ground cover, the water cycle becomes impaired. Infiltration is decreased and runoff is increased because of poor ground cover, rainfall splash, soil capping, low organic matter and poor structure. Because of the very high shrink-swell clay soil and the formation of surface cracks in dry periods, rainfall infiltration can still occur even when ground cover is poor. With a combination of a sparse ground cover and intensive rainfall, this site can contribute to an increased frequency and severity of flooding within a watershed. Soil erosion is accelerated, quality of surface runoff is poor and sedimentation increased.

As the site becomes dominated by woody species, especially oaks and juniper, the water cycle is further altered. Interception of rainfall by tree canopies is increased which reduces the amount of rainfall reaching the surface. Stem flow is increased, however, because of the funneling effect of the canopy, which increases soil moisture at the base of the tree. Increased transpiration, especially when evergreen species such as live oak and juniper dominate, provides less chance for deep percolation into aquifers. As woody species increase, grass cover declines, which causes some of the same results as heavy grazing. Brush management combined with good grazing management can help restore the natural hydrology of the site.

If a mature woodland canopy develops, a buildup of leaf litter occurs which increases the organic litter on the soil, builds structure and retards erosion. The duff, however, can store some moisture and reduce infiltration. Some, but not all values of a properly functioning water cycle are restored on this site when a woodland plant community persists.

Recreational uses

This site has the appeal of the wide open spaces. The abundant tall and mid grasses and scattered oaks produce beautiful fall color variations. The area is also used for hunting, birding, and other eco-tourism related enterprises.

Wood products

Honey mesquite and oaks can be used for firewood and the specialty wood industry.

Other products

None

Other information

None

Inventory data references

Information provided here has been derived from limited NRCS clipping data and from field observations of range trained personnel. Information has also been interpreted from scientific articles.

Type locality

Location 1: Bexar County, TX	
UTM zone	N
UTM northing	3289300.82
UTM easting	541542.267

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Technical reviewers and contributors:
Joe Franklin, Zone Range Management Specialist, NRCS, San Angelo Zone Office, Texas
Ryan McClintock, Biologist, NRCS, San Angelo Zone Office, Texas
Jessica Jobes, Project Leader, Kerrville Soil Survey Office, NRCS, Kerrville, Texas
Travis Waiser, Soil Scientist, NRCS, Kerrville Soil Survey Office, Texas
Wayne Gabriel, Soil Data Quality Specialist, NRCS, Temple, TX
Bryan Hummel, Natural Resources Technician, Joint Base San Antonio-Camp Bullis, Texas
Ann Graham, Editor, NRCS, Temple, Texas

Contributors

Carl Englerth
Mark Moseley
Travis Waiser, MLRA Leader, NRCS, Kerrville, TX

Approval

Bryan Christensen, 9/19/2023

Acknowledgments

Site Development and Testing Plan:

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high-intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

QC/QA completed by:
Bryan Christensen, SRESS, NRCS, Temple, TX
Erin Hourihan, ESDQS, NRCS, Temple, TX

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	San Angelo ZO
Contact for lead author	325-944-0147
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Approved by	Colin Walden
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None.

2. **Presence of water flow patterns:** Some minimal flow patterns may be evident at the juncture of the associated sites.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** None.

5. **Number of gullies and erosion associated with gullies:** None.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

7. **Amount of litter movement (describe size and distance expected to travel):** Little or no litter movement or deposition during normal rainfall events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface is resistant to wind erosion. Stability range is expected to be 5-6.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 0 to 7 inches; very dark reddish brown clay, moderate fine and medium subangular blocky and granular structure; very hard, firm; very sticky and plastic; many fine roots; few fine pores and old root channels; neutral; clear smooth boundary.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The tallgrass/midgrass savanna with abundant forbs, adequate litter, and little bare ground provides for maximum infiltration and negligible runoff

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None.

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Warm-season tallgrasses

    Sub-dominant: Trees = Warm-season midgrasses shrubs/vines Perennial forbs

    Other: Cool-season grasses warm-season shortgrasses

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Perennial grasses will naturally exhibit a minor amount (less than 5%) of senescence and some mortality every year.

14. **Average percent litter cover (%) and depth (in):** Litter is dominantly herbaceous.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 3000 to 5000 pounds per acre.

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that**

become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site: Ashe juniper, pricklypear, yucca, tasajillo, pricklyash, lotebush, mesquite, King Ranch bluestem, silky bluestem, annual broomweed.

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17. **Perennial plant reproductive capability:** All perennial species should be capable of reproducing every year unless disrupted by extended drought, overgrazing, wildfire, insect damage, or other events occuring immediately prior to, or during the reproductive phase.
