# Ecological site R082AY364TX
# Deep Sand 25-32 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.

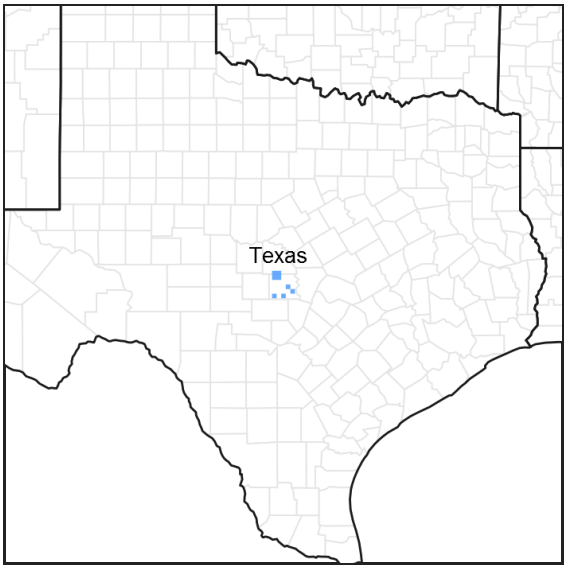



**Figure 1. Mapped extent**

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): 082A–Texas Central Basin

The 82A MLRA is underlain primarily by igneous, metamorphic, and sedimentary rocks. Igneous and metamorphic outcrops include the Valley Spring Gneiss, Packsaddle Schist, and Town Mountain Granite of Precambrian age. Sedimentary rocks include the Hickory Sandstone and Lion Mountain Sandstone of Cambrian Age and the Hensel Sand of Cretaceous age. Holocene alluvium is on flood plains.

## Classification relationships

Major Land Resource Area (MLRA) and Land Resource Unit (LRU) (USDA-Natural Resources Conservation Service, 2006)

## Ecological site concept

Geology: Residuum derived from the Hickory Formation sandstone.

Edaphic: The soils are very deep with more than 40 inches of sand or loamy sand over loamy B horizons with sandstone Cr horizons. The sandy material at the surface allows for rapid infiltration of water during high rainfall events. Available water holding capacity in the upper 60 inches is low.

Vegetation Dynamics: The vegetation is a post oak/blackjack dominated community with scattered shrubs, forbs and tallgrasses. Without periodic fire or brush management, woody species may increase and dominate the site.

## Associated sites

| | |
|---|---|
| R082AY371TX | **Sandstone Hill 25-32 PZ**<br>The Sandstone Hill site are shallower soils with sandy loam surfaces. |
| R082AY368TX | **Loamy Sand 25-32 PZ**<br>The Loamy Sand site has sandy surfaces less than 40 inches deep. |
| R082AY369TX | **Red Sandy Loam 25-32 PZ**<br>The Red Sandy Loam site has sandy loam surfaces. |
| R082AY372TX | **Sandy 25-32 PZ**<br>The Sandy site has coarser textured soils than does the Deep Sand site. |

## Similar sites

| | |
|---|---|
| R082AY372TX | **Sandy 25-32 PZ**<br>The Sandy site has sandy surface 20 to 40 inches thick. |
| R082AY368TX | **Loamy Sand 25-32 PZ**<br>The Loamy Sand site has shallower sandy surface over argillic horizon. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Quercus stellata*<br>(2) *Quercus marilandica* |
| Shrub | (1) *Celtis laevigata*<br>(2) *Smilax bona-nox* |
| Herbaceous | (1) *Eragrostis trichodes*<br>(2) *Sorghastrum nutans* |

## Physiographic features

Geology: Residuum derived from the Hickory Formation sandstone.

Landform/Landscape Position: Footslopes of hillslopes on dissected plateaus

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Plateau > Hillslope |
| Runoff class | Negligible |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 335–518 m |
| Slope | 1–5% |
| Aspect | Aspect is not a significant factor |

## Climatic features

The climate for MLRA 82A is humid subtropical and is characterized by hot summers and relatively mild winters. The average first frost should occur around November 11 and the last freeze of the season should occur around March 21.

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 from the south.

Approximately two-thirds of annual rainfall occurs during the April to September period. Rainfall during this period generally falls as thunderstorms, and fairly large amounts of rain may fall in localized areas for a short period of time.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 215-230 days |
| Freeze-free period (characteristic range) | 240-260 days |
| Precipitation total (characteristic range) | 635-813 mm |
| Frost-free period (actual range) | 215-230 days |
| Freeze-free period (actual range) | 240-260 days |
| Precipitation total (actual range) | 635-813 mm |
| Frost-free period (average) | 225 days |
| Freeze-free period (average) | 250 days |
| Precipitation total (average) | 711 mm |

## Climate stations used

- (1) LLANO [USC00415272], Llano, TX
- (2) MASON [USC00415650], Mason, TX

## Influencing water features

The deep sandy soils allow for good infiltration but often have a low water holding capacity.

## Wetland description

N/A

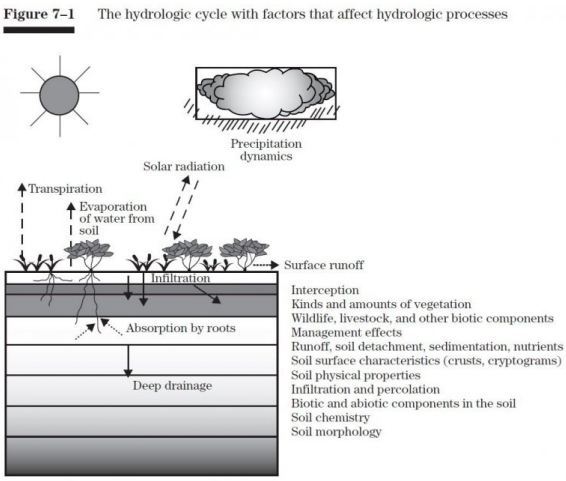



**Figure 8.**

## Soil features

In a representative profile for the Deep Sand ecological site, the soils are very deep over weakly or moderately cemented sandstone. The soil profile typically has a light yellowish brown to very pale brown sand or loamy sand surface with a mottled loamy subsoil. The permeability of the soil is moderate and the permeability of the paralithic material is moderate. The runoff on these sites is typically low to negligible because of the rapid infiltration and

lower slopes but because of the high sand content, the water holding capacity of these soils is low. The depth of soil and lower water holding capacity favors deeper rooted grasses, forbs, and trees. These sites are generally low in fertility. With adequate summer rainfall , these sites can be fairly productive, but when summer rainfall is lacking and with high evapotranspiration rates these sites can be droughty.

Because of 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 ensure the soils are correct for the site.

The representative soil series associated with the Deep Sand ecological site is Matilo.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Residuum–sandstone |
| Surface texture | (1) Sand |
| Family particle size | (1) Loamy |
| Drainage class | Well drained |
| Permeability class | Rapid |
| Depth to restrictive layer | 152–203 cm |
| Soil depth | 152–203 cm |
| Surface fragment cover <=3" | 0–2% |
| Available water capacity (0-101.6cm) | 4.06–9.14 cm |
| Calcium carbonate equivalent (0-101.6cm) | 0% |
| Electrical conductivity (0-101.6cm) | 0–2 mmhos/cm |
| Sodium adsorption ratio (0-101.6cm) | 0–6 |
| Soil reaction (1:1 water) (0-101.6cm) | 5.6–7.3 |
| Subsurface fragment volume <=3" (10.2-101.6cm) | 0–5% |

## Ecological dynamics

The Texas Central Basin (MLRA 82A) is a unique geological region within Texas. It is composed largely of Pre-Cambrian granite, gneiss and schist (Bureau of Economic Geology 1981). Depending upon the parent material and topography, a great variety of soils have developed that vary from shallow, fissured, rocky outcrops with minimal soil development to relatively deep, well-developed soils with textures that vary from fine sandy loams to sands to gravelly clay loams to cobbly clay loams and stony clay loams (Goerdel 2000).

Precipitation patterns are highly variable. Long-term droughts, occurring three to four times per century, cause shifts in species composition by causing a die-off of seedlings, less drought-tolerant species, and some woody species. Droughts also reduce biomass production and create open space that is colonized by opportunistic species when precipitation increases. Wet periods allow little bluestem, sideoats grama, and hardwoods to increase in dominance. The site also tends to have many opportunistic plants such as three-awns (Aristida spp.) and annuals that take advantage of the short flush of available water.

The vegetation of the region developed under a humid, subtropical climate. Weather variation is great; precipitation is highly variable with seasonal, annual, and multi-year droughts (3-6 years) common as well as seasons and years with well above average precipitation; average conditions rarely exist. Typically the spring and fall are periods of highest precipitation while mid to late summer is usually a hot, droughty period. Winters are moderate with scattered precipitation sometimes in the form of short-lived snow and ice storms (Carr 1969, Bomar 1983).

Climatic variation and topographic variability interact to influence vegetation responses to disturbances such as fire and grazing. The herbaceous savannah species adapted to fire and grazing disturbances by maintaining below-ground perennating tissues. Prior to European settlement, fires would likely have been frequent (approximately every 7-12 years) (Scifres and Hamilton 1993, Frost 1998) and burned any time of year as long as there were ample fuels, dry conditions, and an ignition source.

Fire was a major influence on vegetation structure and composition prior to settlement. Lightning and Native Americans were primary ignition sources, and the latter is considered to have increased the frequency and extent of fire as their populations increased. Fires occurred at all seasons but those that occurred during the hot, dry, late-summer season following fine fuel (grass) accumulation in the spring and early summer were perhaps the most intense and had the greatest influence on the character of the vegetation. Fires were frequent, and any area may have burned once within each 7-12 year interval (Scifres and Hamilton 1993, Frost 1998). Fire generally favors the herbaceous component of the community and hinders the establishment and growth of woody species under intense hot, dry conditions. Some trees (e.g. oak species) and resprouting shrubs (e.g. mesquite) were able to escape fires, and as they matured, they became fire-resistant components of the vegetation except for infrequent stand-replacing crown fires. These woody species became effectively uncoupled from the herbaceous and shrub layer even if the herbaceous species composition was substantially altered by grazing or other factors. If, however, the oaks were killed or removed it is very difficult for them to reestablish into mature single-stemmed trees due to the resprouting nature of the tree, particularly under current land use conditions. While fire had influenced these communities for millennia, as the land was settled with homesteads and crops were established, fires were purposely prevented or stopped. Most of the remaining rangeland was overgrazed, which reduced fuel loads and hence effectively fire-proofed the plant communities from the effect of fires. This was a primary factor in the increase of woody species within the Central Basin.

Remnant plant communities that represent the Reference States of ecological sites are difficult to find across much of the Central Basin. While shrublands within MRLA 82 have traditionally been viewed as “degraded” relative to livestock production, it is important to recognize that they are not necessarily degraded from the ecological perspective of primary productivity, biomass accumulation, nutrient cycling, and biodiversity. The productivity of shrublands may be equal to or greater than that of the grassland they replaced. In addition, shrubs help modify soils and microclimate to increase levels of organic matter and nutrients in the upper soils horizons (Boutton et al. 2009, Boutton & Liao 2010). This nutrient enhancement by shrubs can offset grazing-induced losses of soil nutrients and contribute to enhance grass production when shrub cover is reduced. While shrub communities may have adverse impacts on grasses and grassland fauna, other plants and animals may benefit (Archer & Smeins 1991, Bestelmeyer et al. 2003). Thus, while ecosystem biodiversity certainly changes, it does not necessarily decrease with a shift from grass to woody dominance on these sites.

Soil and topographic variation interact with weather variation and land use to produce diverse plant communities across the Central Basin and on the Deep Sand Site. Accounts of earlier explorers and settlers suggest the Central Basin was likely a mosaic of grassland, savannah, and woodlands (Foster 1917). In reference conditions, midgrasses dominated the shortgrasses due to their ability to capture the sunlight and shade as well as being favored by the frequent fires. Plant communities vary from open grassland to savannah/parkland to shrubland/woodland to nearly closed canopy forest. The reference condition for most of the Central Basin and the Deep Sand Ecological Site is defined as the historical (ca. 1800) fire-influenced grassland savannah that was widespread at the time of settlement but which did occur in a mosaic of shrublands, woodlands, and forests across much of the Central Basin (Smeins 1980, Weniger 1984). Almost all sites have a two or three-layered structure of over-story trees, mid-story shrubs and a ground layer of grasses and forbs.

Historical photographs suggest the nature of the vegetation structure depending on topography, soil properties, and time since the last major disturbances (such as drought or fire). However, the occurrence of extensive grasslands and grassland fauna (pronghorn, for example) is mentioned in numerous historical accounts.

Grasses that historically dominate Central Basin sites include little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), meadow dropseed (*Sporobolus compositus*), plains lovegrass (*Eragrostis intermedia*), plains bristlegrass (*Setaria vulpiseta*), Arizona cottontop (*Digitaria californica*), and sand dropseed (*Sporobolus cryptandrus*). Locally abundant tallgrasses include Indiangrass (*Sorghastrum nutans*) and switchgrass (*Panicum virgatum*). Shortgrasses that occur in the understory of mid- and tallgrasses or on shallow soils or disturbed areas include buffalograss (*Bouteloua dactyloides*), common curly-mesquite (*Hilaria belangeri*), hairy grama (*Bouteloua hirsuta*), and red grama (*B. trifida*) (Whitehouse 1933, Riskind and Diamond 1988). The

composition and productivity of grassland communities would have varied with annual rainfall, soil depth, and the extent of argillic horizon development.

Historically, overstory species composition, depending upon the soil, consisted of post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), live oak (*Q. virginiana*), honey mesquite (*Prosopis glandulosa* var. glandulosa), Texas hickory (*Carya texana*), elm species (Ulmus spp.) and others. The shrub layer was potentially diverse with saplings of the tree layer along with whitebrush (*Aloysia gratissima*), lotebush (*Ziziphus obtusifolia*), algerita (Mahonia trifoliata), Texas persimmon (*Diospyros texana*), prickly pear cactus (Opuntia spp.) and others.

With the exception of Ashe juniper (*Juniperus ashei*), all native woody species found in the Central Basin readily resprout following fire. This trait has frustrated managers and played an important role in driving sites towards the Shrubland State. High numbers of fire sprouting shrubs make shrubland communities very resilient.

An important aspect of this site is the relationship of mature hardwood trees to each of the communities. Mature hardwoods are very resilient and remain constant whether surrounded by reference community grasslands, degraded grasslands, native-dominated shrublands, or invasive-dominated shrublands. Their presence or absence is not driven by grazing management and generally only slightly by prescribed fire. They remain relatively stable over a short management period (5-10 years) unless removed by mechanical or chemical means. Throughout this ecological site, mature oaks can occur in any of the communities if they were not historically removed. They are most likely to occur in mottes and remain relatively constant regardless of what is occurring in the rest of the community, particularly in the understory. Communities will have an absence of hardwoods if the hardwoods were harvested, burned, chained, or sprayed at some point. Once the hardwoods are removed, it is not easy to return to the Savannah State due to the difficulty, expense, and time involved.

Hardwoods were frequently removed from this site during the European settlement period due to their high value for construction and firewood. Additionally, many examples exist where hardwoods were removed as part of a broad scale brush removal program. This was done with chaining, herbicides, root plowing, and other general means.

Oak mottes on this site formed under different conditions than currently found. This may be due to climate shift or increased competition from aggressive shrub species. However, while reestablishment is slow, there are many examples of second-growth hardwood woodlands on this site. Hardwoods eventually reestablish when there is a lack of fire or tree clearing.

Infection of live oak by oak wilt (Ceratocystis fagacearum) has led to the death of many individuals and mottes. An increase in tree density and the grafting of roots amongst individuals has facilitated the spread of the pathogen, which is transmitted primarily through root connections (Appel 1995).

Ashe juniper, which is very abundant on the surrounding limestone derived soils of the Edwards Plateau, is relatively uncommon in the Central Basin, but it is found scattered across the Central Basin as infrequent individuals or mottes. Observation indicates that it has been increasing in population and extent within the Central Basin during the past two decades (Walter and Wyatt 1982). Juniper has the ability to take over large tracts of land as near monocultures, known as “cedar breaks.”

Even reference sites show the influence of introduced species. King Ranch bluestem (*Bothriochloa ischaemum*) has become almost ubiquitous, occurring on sites where it has not been seeded. It tends to replace little bluestem (*Schizachyrium scoparium*) and can function similarly in the community as far as structure, size and soil-holding capacity. However, unlike little bluestem, King Ranch bluestem acts like an invader and moves to unoccupied areas.

The large ungulate fauna of the region prior to settlement consisted of bison (Bos bison), pronghorn antelope (Antilocarpa americana) and white-tailed deer (Odocoileus virginianus). Bison and pronghorn occasionally occurred in large numbers and may have intensively grazed the rangelands for short periods. However, they were largely migratory and free-roaming, so that when the forage became limited they moved on, often not to return for long periods. Their long-term impacts on the plant communities were considered to be relatively minor and may have had positive influences on production and diversity (Knapp et al. 1999, Fuhlendorf and Engle 2001).

While archeological evidence indicates that bison occurred in the region, there is also evidence of centuries of absence (Dillehay 1974). In addition, their numbers may have varied seasonally as herds migrated. When present,

bison may have grazed certain areas heavily and then moved on. The infrequent but intense, short-duration grazing by these species suppressed woody species and invigorated herbaceous species (Eidson and Smeins 1999). After a burn, they would intensely graze the burn until no forages remained. Then, they moved off, probably not returning until the next fire cycle, which could have been 5 to 10 years. This suggests heavy short-term grazing followed by long rest periods. Activities of other native herbivores (termites, cutter ants, soil nematodes, kangaroo rats) also influenced vegetation productivity and dynamics.

Currently, white-tailed deer are the primary native 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 helped create population booms. In addition, suppression of fire favored woody plants which provided additional browse and cover for the deer. Due to their impacts on livestock production, large predators (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 & Walker 1965, Bushland 1985).

Recently increased management of the deer herd, because of their economic importance through lease hunting, has decreased deer populations with the objectives of improving individual deer quality and improving habitat. High fences, controlled harvest based on numbers, sex ratios, condition, and monitoring of habitat quality have been effective in managing the deer herd on individual properties. However, across the Central Basin, excess numbers still exist which may lead to habitat degradation and significant die-offs during stress periods such as extended droughts.

The Central Basin is home to a variety of non-indigenous (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.

Supplemental feeding of deer and exotics can also contribute to range degradation if it allows survival of excess numbers of animals.

Feral hogs have become well established within the Central Basin. Hogs use all of the ecological sites within MLRA 82. They cause considerable damage to soils and vegetation.

The faunal array of the Central Basin changed radically with the introduction of domestic species. Early on, wild mustangs released from early Spanish settlements roamed in large herds and had significant impacts on the vegetation. Later in the 19th century, cattle, sheep, goats, mules, and hogs were introduced. The pristine rangeland appeared to provide unlimited forage but as the ranges were fenced and overstocked they were degraded. The productivity of the rangeland began to decline, carrying capacity was reduced, and periodic die-offs of livestock occurred. Generally, the mid and taller grasses were replaced by short grasses and perennial grasses, and forbs were replaced by annuals. These changes not only reduced production but also in many instances caused permanent alteration of the ecological sites due to soil erosion, organic matter loss, compaction, moisture regime change, and other factors which altered many soil and hydrologic processes. This often precluded their recovery to pre-European conditions (Smith 1899, Smeins, Fuhlendorf and Taylor 1997). Not only did livestock overgraze the forage, but they also contributed to seed dispersal of some woody plants, particularly honey mesquite, which exacerbated its increase on the rangelands.

Historical accounts prior to the 1800s also identify grazing by herds of wild horses, followed by heavy grazing by sheep and cattle as settlement progressed. Grazing on early ranches changed natural graze-rest cycles to continuous grazing and stocking rates exceeded the carrying capacity. By the early 1800s cattle, sheep, and goat numbers appear to have been quite high in the Central Basin, resulting in heavy, year-round grazing (Lehman 1969). Sheep numbers peaked at 10.8 million head in 1943 and stood at about 1.2 million in 2000. Goat numbers in

Texas around 1900 were around 100,000. They peaked in 1965 at 4.6 million and were 345,000 in 2000 (Texas Online). The Central Basin and Edwards Plateau region, because of its climate and diverse vegetation, was the mainstay of the Texas sheep and goat industry.

Today, beef cattle and horses are the primary grazers in the area. Goats used primarily for meat production are locally important, and their numbers have increased. Sheep remain a minor but still important part of livestock grazing in the Central Basin. White-tailed deer, wild turkey, bobwhite quail, and doves are major commercial wildlife species, and hunting leases are a major source of income for many landowners. While the Central Basin ecological sites have changed in many ways since settlement, opportunities exist to produce products and provide income while conserving and sustaining the long-term stability and productivity of the area.

Homesteads and communities developed along with ranching, and many ecological sites within MLRA 82 were converted to cropland for wheat (Triticum spp.), oats (Avena spp.), forage, peanuts (*Arachis hypogaea*), and other products needed for local consumption or for cash crops. This conversion effectively eliminated the native plant communities due to land clearing and the harvest of larger trees, used for building construction among other uses.

Over time, as many of the croplands became degraded, and along with the rangeland that had been overused, introduced forages were brought in to assist with soil and water conservation and to increase productivity. Coastal bermudagrass (*Cynodon dactylon*), Kleingrass (*Panicum coloratum*), Wilman lovegrass (*Eragrostis superba*), and King Ranch bluestem were widely planted on many acres of old cropland and in areas with deeper soils. The latter, while effective as a soil stabilizer, has become invasive in many areas, including sites with shallower soils. It is difficult to control.

In the 1940s, mechanical and herbicide treatments began to replace fire as a control of increasing density of woody plants on the rangeland. This activity was common practice for several decades until the 1980s, when these treatments became less cost-effective. It was clear that brush management practices were treating symptoms rather than underlying problems in addition to their undesirable environmental and wildlife consequences. Sites cleared of brush regenerated rapidly and often formed thickets that were denser and of lower diversity than the original stands. This realization coupled with the fact that brush management treatments were typically expensive and short-lived, lead to the development of Integrated Brush Management Systems (Scifres et al. 1985). This approach takes a holistic, large-scale, long-term, socioeconomic, ecosystem-based approach to brush management and recognizes multiple-use options for rangeland resources including alternate classes of livestock, lease hunting, exotic game ranching, carbon credits and ecotourism.

Grazing and fire are two factors that critically influence the relative abundance of grasses and woody plants through time. The resulting reduction in abundance of late seral grasses lead to a decline in soil organic matter, a reduction in fire frequency/intensity (due to lack of fine fuels), and a shift in dominance from midgrasses (little bluestem and sideoats grama) to shortgrasses {hooded windmillgrass (*Chloris cucullata*) and buffalograss} and forbs {Mexican sagewort (*Artemisia ludoviciana* ssp. Mexicana) and croton (Croton spp.)}. These changes would have favored woody plants, most of which are unpalatable to livestock, and enabled them to establish and maintain dominance.

Mesquite, whitebrush, juniper, lotebush, algerita, persimmon, prickly pear, and lime pricklyash (Zanthoxylum fagar) now dominate much of the Central Basin. These woody plants are not ‘new arrivals’ but rather, are native to the region and have increased in size and abundance within their historic ranges. Factors promoting their increase in abundance since European settlement are the subject of active debate. Such factors may involve an interactive combination of changes in climate, intensification of grazing; follow up brush management and reductions in fire frequency/intensity accompanied by increases in atmospheric CO2 concentrations and nitrogen deposition since the industrial revolution (Archer 1994).

A State and Transition Model diagram for the Deep Sand Ecological Site (R082AY364TX) is depicted in Figure 1. Thorough 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 due to the naturally occurring variability in weather, soils, and aspect. The savannah state is the reference state for this site. It 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

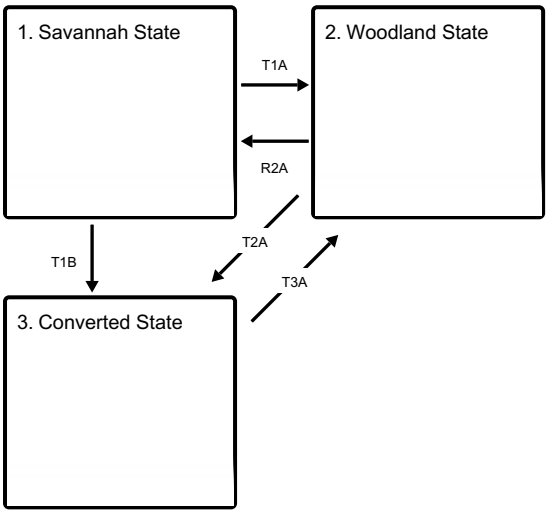
presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by weight and percent canopy cover are used in this ESD. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs). Canopy cover drives 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 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, natural regeneration over time, and prolonged excessive grazing pressure

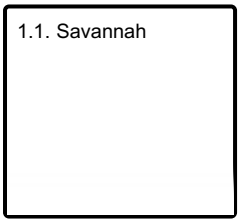
**T1B** - Extensive soil disturbance followed by seeding

**R2A** - Removal of woody canopy and reintroduction of historic disturbance return intervals

**T2A** - Extensive soil disturbance followed by seeding

**T3A** - Absence of disturbance, natural regeneration over time, and prolonged excessive grazing pressure

**State 1 submodel, plant communities**




## State 1
## Savannah State

The Savannah State is the reference state. The information was taken from a Range Site Description, approved 3-11-1987. The plant community is a post oak and blackjack oak dominance with noticeable absence of little bluestem. The woody cover makes a 40 to 60 percent canopy cover. A few tallgrasses occur in the scattered open areas. Forbs, legumes, woody vines and shrubs add to the variety of the historic plant community. Relatively frequent fires (7-12 year mean fire return interval) (Frost 1998) maintained the open areas by minimizing shrub cover that was not yet to a fire resistant height. Mature single stemmed hardwoods were long-lived and resistant to

ground fires. Fires were natural or human-induced. When fires were frequent on the savannah, most fires burned only the understory, leaving mottes of trees. Even with proper grazing and favorable climate conditions, a long time lack of fire or brush management will allow trees and shrubs to increase in canopy to reach the 60 percent level that indicates the shift to the Woodland State. This transition is not so much dependent on degradation of the herbaceous community as on the lack of some form of brush control and the reduction in fire. Once the site had dense tree cover, the site would be resistant to fires and a very resilient woodland community would develop. Grazing management alone cannot maintain the site in the Savannah State. The Savannah State always has potential for shrub dominance without fire. Mann (2004) discussed the importance of human induced fire as an important factor in maintaining open grasslands before European settlement. A major role of grazing management is to build and preserve fine fuel to carry maintenance fires. Brush control can play a similar role that natural fires played pre-settlement. However, it is difficult to manage in an ecological and economic matter on a small scale, as this site is rapidly repopulated by shrubs and trees without fire or brush management. Brush control may be prescribed fire, mechanical, chemical or biological control, or targeted grazing (generally by goats, although some instances exist in the Central Basin where exotic wildlife species or overpopulated white-tailed deer reduce woody cover). There are examples of this site being maintained as a savannah with introduced hay meadows and mottes of trees. Total annual production varies from 1800 - 2700 air-dry pounds per acre depending upon growing conditions.

**Dominant plant species**

- post oak (*Quercus stellata*), tree
- sand lovegrass (*Eragrostis trichodes*), grass
- Indiangrass (*Sorghastrum nutans*), grass

## Community 1.1
## Savannah

The Savannah State is the reference state. The information was taken from a Range Site Description, approved 3-11-1987. The plant community is a post oak and blackjack oak dominance with a noticeable absence of little bluestem. The woody cover makes a 40 to 60 percent canopy cover. A few tallgrasses occur in the scattered open areas. Forbs, legumes, woody vines and shrubs add to the variety of the historic plant community.

**Table 5. Annual production by plant type**

| Plant Type | Low (Kg/Hectare) | Representative Value (Kg/Hectare) | High (Kg/Hectare) |
|---|---|---|---|
| Tree | 1009 | 1261 | 1513 |
| Grass/Grasslike | 908 | 1121 | 1362 |
| Forb | 101 | 126 | 151 |
| Shrub/Vine | – | 28 | 56 |
| **Total** | **2018** | **2536** | **3082** |

## State 2
## Woodland State

The Woodland State is characterized by trees, a significant shrub cover, and a shortgrass- understory having over 60 percent woody plant canopy, dominated by hardwoods and shrubs. The Woodland State loses its savannah appearance with native shrubs beginning to fill the open grassland portion of the savannah. Shade from overstory is the driving factor. This community results from the lack of effective brush control. Production of the overstory canopy has increased by a similar amount to the decrease in herbaceous production. Unpalatable woody species have increased in size and density. Without brush control, tree canopy will continue to increase until canopy cover approaches 80 percent. Ground cover and herbaceous production beneath shrub canopies is minimal, but soil organic carbon and nitrogen levels are enhanced. In this State, annual production is dominated by woody species. Goats and deer can find fair food value if browse plants have not been grazed excessively. Forage quantity and quality for cattle is low. Over-browsing coupled with the shading effect of the overstory will result in a visible browse line. Intensive treatment is required to affect restoration back to the Savannah State (1.0). Prescribed burning may not be possible until the woody cover is reduced by herbicides or mechanical treatments to the point that grasses

(fine fuels) can establish. Brush treatment tends to be short-lived. Observation shows that even effective treatment will require constant maintenance to suppress brush reestablishment. Without maintenance, canopy cover may exceed 30 percent in 3 to 5 years.

**Dominant plant species**

- post oak (*Quercus stellata*), tree
- Ashe's juniper (*Juniperus ashei*), tree

## State 3
## Converted State

The Converted Land State occurs when the site, either the Savannah State (1.0) or Woodland State (2.0), is cleared and plowed for planting to cropland, hayland, native grasses, tame pasture, or use as non-agricultural land. The native component is usually lost when seeding non-natives. Even when reseeding with natives, the ecological processes defining the past states of the site can be permanently changed. Agronomic practices are used typically with non-native forages. Cropland and tame pasture require repeated and continual inputs of fertilizer and weed control to maintain the Converted State. Common introduced species include hybrid bermudagrass, Kleingrass, Wilman lovegrass, and Old World bluestems (Bothriochloa spp.). Newly seeded stands are prone to invasion by annual and perennial weeds and woody plants, so proper grazing and brush/weed management are required for their maintenance. The rate of woody plant re-establishment will depend on the brush management practice initially used to clear the site, seedbed preparation technique, proximity to undisturbed shrub stands and the rate of livestock and wildlife transporting seeds. Stands seeded to native grasses are also susceptible to invasion by non-native, aggressive pasture grasses such as King Ranch bluestem and seeded bermudagrass. These exotic species, while providing forage and soil stability, may be very difficult to eliminate once established. Production of these introduced forage grasses may exceed that of native grasses when fertilized. However, the extent to which introduced grasses provide better forage than native grasses is debatable, especially when their adverse effects on wildlife are taken into account. Conversion of introduced pasture back to native grassland is difficult and typically requires aggressive and costly management intervention. Given the potential adverse long-term effects of exotic grasses on native grassland flora and fauna, their use should be critically and carefully considered.

**Dominant plant species**

- yellow bluestem (*Bothriochloa ischaemum*), grass

## Transition T1A
## State 1 to 2

Abusive harvest of herbaceous vegetation, removal of fire, and no brush management results in the sunlight energy being harvested more by woody species than by grasses. Drought can hasten the process. There is an increase of woody canopy which can reach 60 percent.

## Transition T1B
## State 1 to 3

Land clearing, tillage, and replanting to exotic or native forage species drive the Transition to the Converted State. The sun's energy now goes exclusively to herbaceous grasses, as does the available rainfall.

## Restoration pathway R2A
## State 2 to 1

Prescribed grazing and Range Planting increases the herbaceous component of the plant community. Brush management and prescribed burning can also assist with the recovery. One role of prescribed grazing is to build and maintain fuel needed for fire and to restore the flow of sunlight energy back to the tall and mid grasses. Even though full restoration to the historic community is doubtful due to loss of species and possible soil damage, something similar with similar function can be achieved.

**Conservation practices**

| |
|---|
| Brush Management |
| Prescribed Burning |
| Range Planting |
| Prescribed Grazing |

### Transition T2A
### State 2 to 3

The sunlight energy and the water cycle is devoted to primarily grass forage plants. Land clearing and usually tillage are needed for the Transition.

### Transition T3A
### State 3 to 2

Abandonment, lack of brush management, and/or abusive grazing can allow brush to establish. Over time, the brush will intercept more and more of the sunlight energy and the rainfall resources until it dominates.

## Additional community tables

**Table 6. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Kg/Hectare) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **warm season Tall/Mid grasses** | | | 272–409 | |
| | sand lovegrass | ERTR3 | *Eragrostis trichodes* | 504–757 | – |
| | Indiangrass | SONU2 | *Sorghastrum nutans* | 202–303 | – |
| | switchgrass | PAVI2 | *Panicum virgatum* | 101–151 | – |
| | red lovegrass | ERSE | *Eragrostis secundiflora* | 20–30 | – |
| | purpletop tridens | TRFL2 | *Tridens flavus* | 20–30 | – |
| 2 | **warm season short grasses** | | | 61–91 | |
| | Heller's rosette grass | DIOL | *Dichanthelium oligosanthes* | 20–30 | – |
| | thin paspalum | PASE5 | *Paspalum setaceum* | 20–30 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 20–30 | – |
| **Shrub/Vine** | | | | | |
| 3 | **Shrubs** | | | 61–91 | |
| | hackberry | CELTI | *Celtis* | 0–28 | – |
| | pricklypear | OPUNT | *Opuntia* | 0–28 | – |
| | gum bully | SILA20 | *Sideroxylon lanuginosum* | 0–28 | – |
| | saw greenbrier | SMBO2 | *Smilax bona-nox* | 0–28 | – |
| | grape | VITIS | *Vitis* | 0–28 | – |
| | lime pricklyash | ZAFA | *Zanthoxylum fagara* | 0–28 | – |
| **Tree** | | | | | |
| 4 | **Trees** | | | 948–1422 | |
| | post oak | QUST | *Quercus stellata* | 545–817 | – |
| | blackjack oak | QUMA3 | *Quercus marilandica* | 404–605 | – |
| **Forb** | | | | | |
| 5 | **Forbs** | | | 101–151 | |
| | buffalobur nightshade | SORO | *Solanum rostratum* | 56–106 | – |
| | fuzzybean | STROP | *Strophostyles* | 28–84 | – |
| | whitemouth dayflower | COER | *Commelina erecta* | 28–84 | – |
| | lespedeza | LESPE | *Lespedeza* | 28–56 | – |

## Animal community

The site is inhabited by deer, turkey, dove, and quail. Because of extreme brush density, this site makes only fair to poor wildlife habitat.

## Hydrological functions

These undulating uplands have rapid permeability, slow runoff, and are somewhat excessively drained. Because of rapid permeability, water erosion is not a problem.

## Recreational uses

Bluebonnets, Indian paintbrush, and phlox are just a few of the beautiful flowers which grow on this site.

## Other information

This rating system provides general guidance as to animal forage preference for plant species. It also indicates possible competition between kinds of herbivores for various plants. Grazing preference changes from time to time, especially between seasons, and between animal kinds and classes. Grazing preference does not necessarily reflect the ecological status of the plant within the plant community. For wildlife, plant preferences for food, and plant suitability for cover are rated. Refer to habitat guides for a more complete description of a species habitat needs.

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## 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
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## 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) | |
| Contact for lead author | |
| Date | 05/19/2024 |
| Approved by | Bryan Christensen |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:**

   _____

2. **Presence of water flow patterns:**

   _____

3. **Number and height of erosional pedestals or terracettes:**

   _____

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

   _____

5. **Number of gullies and erosion associated with gullies:**

   _____

6. **Extent of wind scoured, blowouts and/or depositional areas:**

   _____

7. **Amount of litter movement (describe size and distance expected to travel):**

   _____

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

   _____

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

   _____

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

    _____

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

    _____

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:

    Sub-dominant:

    Other:

    Additional:

    _____

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth ( in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

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:**

---

17. **Perennial plant reproductive capability:**

---