USDA Natural Resources Conservation Service

Ecological site R086AY012TX
Loamy Bottomland

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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.

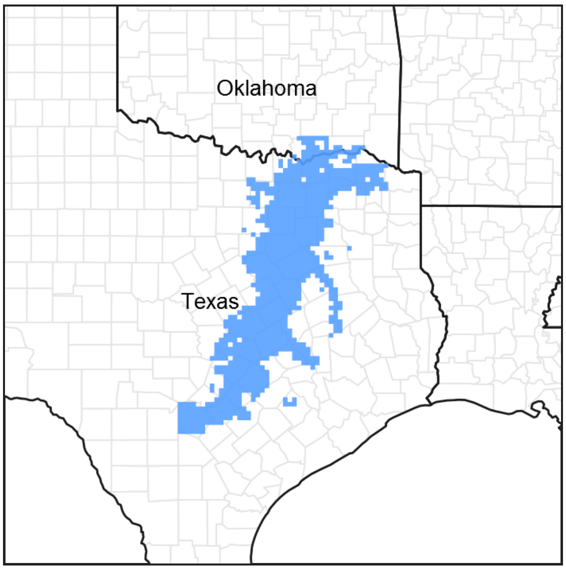


Figure 1. Mapped extent

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): 086A–Texas Blackland Prairie, Northern Part

MLRA 86A, The Northern Part of Texas Blackland Prairie is entirely in Texas. It makes up about 15,110 square miles (39,150 square kilometers). The cities of Austin, Dallas, San Antonio, San Marcos, Temple, and Waco are located within the boundaries. Interstate 35, a MLRA from San Antonio to Dallas. The area supports tall and mid-grass prairies, but improved pasture, croplands, and urban development account for the majority of the acreage.

Classification relationships

USDA-Natural Resources Conservation Service, 2006.
-Major Land Resource Area (MLRA) 86A

Ecological site concept

The Loamy Bottomland is a tallgrass savannah. The site is unique because it has a hardwood overstory component with the tallgrasses. The soils are very deep loams and are associated with flooding regimes. The loamy textured soils allow the water to drain and sites do not usually flood for longer than seven days.

Associated sites

R086AY006TX	**Northern Clay Loam** The Northern Clay Loam site is often upslope from the Loamy Bottomland site. It differs from the Loamy Bottomland site by occurring in uplands, plains, and terraces and lacking thin stratas of varying textured soils in the soil profile from flooding events.
R086AY007TX	**Southern Clay Loam** The Southern Clay Loam site is often upslope from the Loamy Bottomland site. It differs from the Loamy Bottomland site by occurring in uplands, plains, and terraces and lacking thin stratas of varying textured soils in the soil profile from flooding events.
R086AY010TX	**Northern Blackland** The Northern Blackland site is often upslope from the Loamy Bottomland site. It differs from the Loamy Bottomland site by its position on uplands, high shrink-swell properties, and having clay soils and higher runoff.
R086AY011TX	**Southern Blackland** The Southern Blackland site is often upslope from the Loamy Bottomland site. It differs from the Loamy Bottomland site by its position on uplands, high shrink-swell properties, and having clay soils and higher runoff.

Similar sites

R086AY013TX	**Clayey Bottomland** The Clayey Bottomland site is similar to the Loamy Bottomland site by occurring on floodplains and having similar production potential. It differs from the Loamy Bottomland site by having clay soils with high shrink-swell properties, inclusions of hydric soils, and very slow permeability. The clayey bottomland does not produce as much as the Loamy Bottomland.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Sorghastrum nutans* (2) *Tripsacum dactyloides*

Physiographic features

These are on nearly level slopes on floodplains. Slopes can range from 0 to 8 percent, but are usually 1 to 3 percent. The sites flood throughout the year, but the water does not usually persist longer than seven days. The runoff class is negligible to low.

Table 2. Representative physiographic features

Landforms	(1) Plains > Flood plain
Runoff class	Negligible to low
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to frequent
Ponding frequency	None
Elevation	200–2,300 ft
Slope	0–8%
Water table depth	30–72 in
Aspect	Aspect is not a significant factor

Climatic features

The climate for MLRA 86A is humid subtropical and is characterized by hot summers, especially in July and August, and relatively mild winters. Tropical maritime air controls the climate during spring, summer and fall. In winter and early spring, frequent surges of Polar Canadian air cause sudden drops in temperatures and add considerable variety to the daily weather. When these cold air masses stagnate and are overrun by moist air from the south, several days of cold, cloudy, and rainy weather follow. Generally, these occasional cold spells are of short duration with rapid clearing following cold frontal passages. The summer months have little variation in day-to-day weather except for occasional thunderstorms that dissipate the afternoon heat. The moderate temperatures in spring and fall are characterized by long periods of sunny skies, mild days, and cool nights. The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time during the summer and 50 percent in winter. The prevailing wind direction is from the south and highest wind speeds occur during the spring months. Rainfall during the spring and summer months generally falls during thunderstorms, and fairly large amounts of rain may fall in a short time. High-intensity rains of short duration are likely to produce rapid runoff almost anytime during the year. The predominantly anticyclonic atmospheric circulation over Texas in summer and the exclusion of cold fronts from North Central Texas result in a decrease in rainfall during midsummer. The amount of rain that falls varies considerably from month-to-month and from year-to-year.

Table 3. Representative climatic features

Frost-free period (average)	237 days
Freeze-free period (average)	265 days
Precipitation total (average)	39 in

Climate stations used

- (1) JOE POOL LAKE [USC00414597], Dallas, TX
- (2) KAUFMAN 3 SE [USC00414705], Kaufman, TX
- (3) NEW BRAUNFELS [USC00416276], New Braunfels, TX
- (4) SAN ANTONIO 8NNE [USC00417947], San Antonio, TX
- (5) CEDAR CREEK 5 S [USC00411541], Cedar Creek, TX
- (6) HILLSBORO [USC00414182], Hillsboro, TX
- (7) MCKINNEY [USC00415766], McKinney, TX
- (8) TEMPLE [USC00418910], Temple, TX
- (9) WAXAHACHIE [USC00419522], Waxahachie, TX
- (10) GREENVILLE KGVL RADIO [USC00413734], Greenville, TX
- (11) SAN MARCOS [USC00417983], San Marcos, TX
- (12) SHERMAN [USC00418274], Denison, TX
- (13) TAYLOR 1NW [USC00418862], Taylor, TX
- (14) AUSTIN BERGSTROM AP [USW00013904], Austin, TX

Influencing water features

This site is located in floodplains. It receives water from overflow from watercourses and runoff from higher adjacent sites.

Wetland description

All soils within this site are classified as hydric and may be wetlands. Onsite delineations are required to determine if the site is officially classified as a wetland.

Soil features

The site consists of very deep, well to somewhat poorly drained soils with moderate to very slow permeability. The floodplain soils were formed in recent alluvium. In a representative profile the surface layer is dark grayish brown loam about 29 inches deep. The subsoil is brown clay loam or silty clay loam to a depth of more than 60 inches from the soil surface. Thin stratas of varying textured soils are present throughout this soil as evidence of flooding events.

Associated soil series include: Bergstrom, Bosque, Bunyan, Frio, Gowen, Highbank, Hopco, Kemp, Oakalla, Pursley, Seguin, Uhland, Weswood, Whitesboro, and Yahola.

Table 4. Representative soil features

Parent material	(1) Alluvium–mudstone
Surface texture	(1) Loam (2) Fine sandy loam (3) Silt loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat poorly drained
Permeability class	Moderate to very slow
Soil depth	80 in
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	5–7 in
Calcium carbonate equivalent (0-40in)	2–40%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–2
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–6%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

Introduction – The Northern Blackland Prairies are a temperate grassland ecoregion contained wholly in Texas, running from the Red River in North Texas to San Antonio in the south. The region was historically a true tallgrass prairie named after the rich dark soils it was formed in. Other vegetation included deciduous bottomland woodlands along rivers and creeks.

Background – Natural vegetation on the uplands is predominantly tall warm-season perennial bunchgrasses with lesser amounts of midgrasses. This tallgrass prairie was historically dominated by big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), eastern gamagrass (*Tripsacum dactyloides*), and little bluestem (*Schizachyrium scoparium*). Midgrasses such as sideoats grama (*Bouteloua curtipendula*), Virginia wildrye (*Elymus virginicus*), Florida paspalum (*Paspalum floridanum*), Texas wintergrass (*Nassella leucotricha*), hairy grama (*Bouteloua hirsuta*), and dropseeds (Sporobolus spp.) are also abundant in the region. A wide variety of forbs add to the diverse native plant community. Mottes of live oak (*Quercus virginiana*) and hackberry (Celtis spp.) trees are also native to the region. In some areas, cedar elm (*Ulmus crassifolia*), eastern red cedar (*Juniperus virginiana*), and honey locust (*Gleditsia triacanthos*) are abundant. In the Northern Blackland Prairie oaks (Quercus spp.) are common increasers, but in the Southern Blackland Prairie oaks are less prevalent. Junipers are common invaders, particularly in the northern part of the region.

During the first half of the nineteenth century, row crop agriculture lead to over 80 percent of the original vegetation lost. During the second half, urban development has caused even an even greater decline in the remaining prairie.

Today, less than one percent of the original tallgrass prairie remains. The known remaining blocks of intact prairie range from 10 to 2,400 acres. Some areas are public, but many are privately owned and have conservation easements.

Current State – Much of the area is classified as prime farmland and has been converted to cropland. Most areas where native prairie remains have histories of long-term management as native hay pastures. Tallgrasses remain dominant when haying of warm-season grasses is done during the dormant season or before growing points are elevated, meadows are not cut more than once, and the cut area is deferred from grazing until frost.

Due to the current-widespread farming, the Northern Blackland Prairie is still relatively free from the invasion of brush that has occurred in other parts of Texas. In contrast, many of the more sloping have experienced heavy brush encroachment, and the continued increase of brush encroachment is a concern. The shrink-swell and soil cracking characteristics of the soils favor brush species with tolerance for soil movement.

Current Management – Rangeland and pastureland are grazed primarily by beef cattle. Horse numbers are increasing rapidly in the region, and in recent years goat numbers have increased significantly. There are some areas where dairy cattle, poultry, goats, and sheep are locally important. Whitetail deer, wild turkey, bobwhite quail, and dove are the major wildlife species, and hunting leases are a major source of income for many landowners in this area.

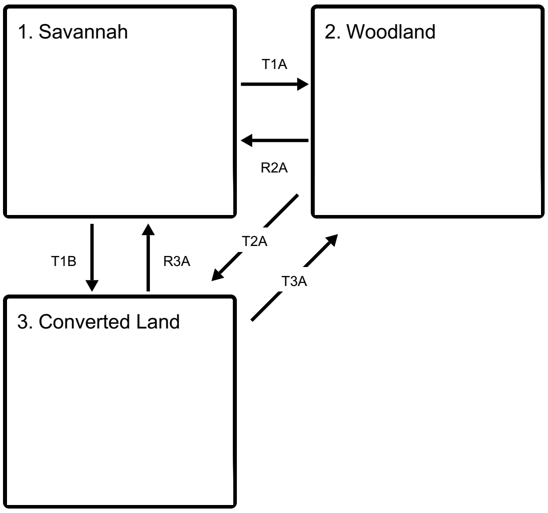
Introduced pasture has been established on many acres of old cropland and in areas with deeper soils. Coastal bermudagrass (*Cynodon dactylon*) and kleingrass (*Panicum coloratum*) are by far the most frequently used introduced grasses for forage and hay. Hay has also been harvested from a majority of the prairie remnants, where long-term mowing at the same time of year has possibly changed the relationships of the native species. Cropland is found in the valleys, bottomlands, and deeper upland soils. Wheat (Triticum spp.), oats (Avena spp.), forage and grain sorghum (Sorghum spp.), cotton (Gossypium spp.), and corn (*Zea mays*) are the major crops in the region.

Fire Regimes – The prairies were a disturbance-maintained system. Prior to European settlement (pre-1825), fire and infrequent, but intense, short-duration grazing by large herbivores (mainly bison and to a lesser extent pronghorn antelope) were important natural landscape-scale disturbances that suppressed woody species and invigorated herbaceous species (Eidson and Smeins 1999). The herbaceous prairie species adapted to fire and grazing disturbances by maintaining below-ground penetrating tissues. Wright and Bailey (1982) report that there are no reliable records of fire frequency occurring in the Great Plains grasslands because there are no trees to carry fire scars from which to estimate fire frequency. Because prairie grassland is typically of level or rolling topography, a natural fire frequency of 5 to 10 years seems reasonable.

Disturbance Regimes - Precipitation patterns are highly variable. Long-term droughts, occurring three to four times per century, cause shifts in species composition by causing die-off of seedlings, less drought-tolerant species, and some woody species. Droughts also reduce biomass production and create open space, which is colonized by opportunistic species when precipitation increases. Wet periods allow tallgrasses to increase in dominance. These natural disturbances cause shifts in the states and communities of the ecological sites.

State and transition model

Ecosystem states



T1A - No fire, no brush management, improper grazing management, drought

T1B - Brush management, crop cultivation, pasture planting, nutrient management, pest management

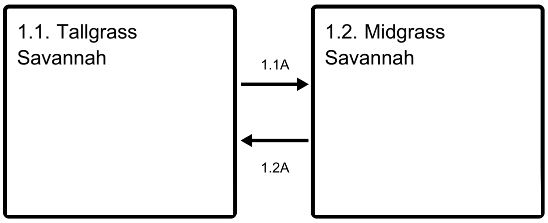
R2A - Fire, brush management, proper grazing, range planting

T2A - Brush management, crop cultivation, pasture planting, nutrient management, pest management

R3A - Fire, brush management, proper grazing, range planting

T3A - No fire, no brush management, heavy continuous grazing, no pest management

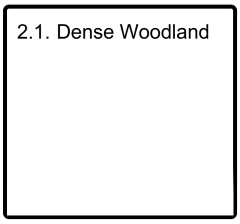
State 1 submodel, plant communities



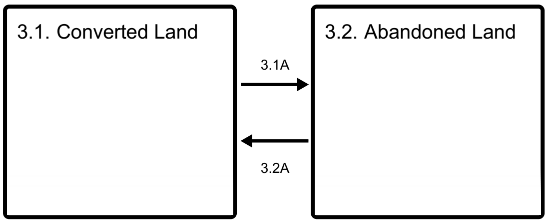
1.1A - No fire, no brush management, improper grazing management, drought

1.2A - Fire, brush management, proper grazing

State 2 submodel, plant communities



State 3 submodel, plant communities



3.1A - No fire, no brush management, heavy continuous grazing, no pest management

3.2A - Fire, brush management, proper grazing, pest management

State 1

Savannah

Two communities exist in the Savannah State: the 1.1 Tallgrass Savannah Community and the 1.2 Midgrass Savannah Community. Community 1.1 is characterized by tallgrasses dominating the understory with woody species creating less than 20 perecent of the canopy cover. Community 1.2 is characterized by midgrasses dominating the understory and woody species making up 20 to 50 perecent of the overstory canopy cover.

Community 1.1
Tallgrass Savannah

The Tallgrass Savannah Community (1.1) is the reference community and is characterized as a hardwood savannah with up to 20 percent tree and shrub canopy cover. Historic records in the 1700's do, however, indicate that early settlers and explorers found portions of this site to be heavily wooded. Other reports (Mann 2004) discuss the importance of human caused fire as an important factor in keeping open grasslands prior to European settlement. It is assumed the Tallgrass Savannah Community (1.1) occurred over the majority of this ecological site in a dynamically shifting mosaic over time with the other communities in the Savannah State. Canopy cover drives the transitions between plant communities and states because of the influence of shade and interception of rainfall. Eastern gamagrass, Virginia wildrye, Canada wildrye (*Elymus canadensis*), sedges (Carex spp.), switchgrass, Indiangrass, big bluestem, little bluestem, beaked panicum (*Panicum anceps*), and rustyseed paspalum (*Paspalum langei*) dominate the herbaceous component of the site. Forbs commonly found on the site include tickclover (Desmodium spp.), wildbeans (Strophostyles spp.), lespedezas (Lespedeza spp.), and partridge pea (*Chamaecrista fasciculata*). Shrub and tree species found in the Tallgrass Savannah Community (1.1) include species of oaks (Quercus spp.), pecan (Carya illinoensis), hackberry, and elm (Ulmus spp.). Vines include greenbrier (Smilax spp.), grape (Vitis spp.), honeysuckle (Lonicera spp.), and peppervine (Ampelopsis spp.). The reference savannah community will shift to the Midgrass Savannah Community (1.2) under the stresses of improper grazing. The first species to decrease in dominance will be the most palatable grasses and forbs (namely, eastern gamagrass, Indiangrass, and big bluestem). This will initially result in an increase in composition of little bluestem and paspalums. If improper grazing continues, little bluestem will decrease and midgrasses such as broomsedge bluestem (*Andropogon virginicus*) and Vaseygrass (*Paspalum urvillei*) will increase in composition. Less palatable forbs will also increase at this stage. Without fire and/or brush control, woody species on the site will increase and transition the site to the Woodland State. This can occur with or without the understory transitioning to the midgrass community. This transition can occur without degradation of the herbaceous community from dominance by tallgrasses to dominance by midgrasses. Brown and Archer (1999) concluded that even with a healthy and dense stand of grasses, woody species will populate the site and eventually dominate the community. Because the woody species that dominate in the Woodland State are native species that occur as part of the Savannah State, the transition to the Woodland State is a linear process with shrubs starting to increase soon after fire or brush control ceases. Unless some form of brush control takes place, woody species will increase to the 50 percent canopy cover level that indicates a state change. This is a continual process. Managers need to detect the increase in woody species when canopy is less than 50 percent and take management action before the state change occurs. There is not a 10-year window before shrubs begin to increase followed by a rapid transition to the Woodland State. The drivers of the transition (lack of fire and lack of brush control) constantly pressure the system towards the Woodland State. The soils of this site are deep, loamy textured, and moderately permeable. The site generally receives additional water from outside the site. Infiltration is moderate and runoff is low. There is essentially no bare soil in this community. Plant basal cover and litter comprise all of the ground cover. Soils are highly fertile and hold moderately large amounts of soil moisture. This is a very productive site with high yields of good quality forage.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	3000	4500	6375
Shrub/Vine	800	1200	1700
Forb	200	300	425
Total	**4000**	**6000**	**8500**

Community 1.2
Midgrass Savannah

The Midgrass Savannah Community (1.2) typically results from improper cattle grazing management over a long period of time combined with a lack of brush control. Indigenous or invading woody species increase on the site (with or without fire). Growing season stress, usually from overgrazing, causes reduction in vigor and survival of tallgrasses, which allows midgrasses and less palatable forbs to increase in the herbaceous community. When the Midgrass Savannah Community (1.2) is continually overgrazed and fire is excluded, the community shifts to a community dominated by woody plants, the Dense Woodland Community (2.1). Important grasses are little bluestem, broomsedge bluestem (*Andropogon virginicus*), bushy bluestem (*Andropogon glomeratus*), and Vaseygrass. Unpalatable, shade-tolerant grasses and forbs begin replacing the midgrasses. Examples include cocklebur (*Xanthium spinosum*), sumpweed (Cyclachaena xanthifolia), and beebalm (Monarda spp.). Shaded conditions favor cool-season grasses such as Texas wintergrass and woodoats (Chasmanthium spp.). Woody canopy varies between 30 and 50 percent, depending on the severity of grazing, fire interval, amount of brush control, and availability of increaser species. Numerous shrub and tree species will encroach because overgrazing by livestock has reduced grass cover, exposed more soil, and reduced grass fuel for fire. Typically, trees such as oaks and ash (Fraxinus spp.) will increase in size, while other tree and shrub species such as bumelia (Sideroxylon spp.), sumacs (Rhus spp.), honey locust, winged elm (*Ulmus alata*), and osage orange (*Maclura pomifera*) will increase in density. To control woody species populations, prescribed grazing and/or browsing and fire can be used to control smaller shrubs and trees, and mechanical removal of larger shrubs and trees may be necessary in older stands. Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose the soil to erosion. Litter and mulch will move off-site as plant cover declines. Increasing woody dominants are oaks and eastern red cedar (*Juniperus virginiana*). Once the tallgrasses have been reduced on the site, woody species cover exceeds 50 percent canopy cover, and the woody plants within the grassland portion of the savannah reach fire-resistant size (over three feet in height), the site crosses a threshold into the Woodland Community (2.1) in the Woodland State (2). Until the Midgrass Savannah Community (1.2) crosses the threshold into the Dense Woodland Community (2.1), this community can be managed back toward the Savannah State (1.1) through the use of management practices including prescribed grazing, prescribed burning, and strategic brush control. It may take several years to achieve this state, depending upon the climate and the aggressiveness of the treatment. Once invasive woody species begin to establish, returning fully to the native community is difficult, but it is possible to return to a similar plant community. Potential exists for soils to erode to the point that irreversible damage may occur. If soil-holding herbaceous cover decreases to the point that soils are no longer stable, the shrub overstory will not prevent erosion of the A and B soil horizons. This is a critical shift in the ecology of the site. Once the A horizon has eroded, the hydrology, soil chemistry, soil microorganisms, and soil physics are altered to the point where intensive restoration is required to restore the site to another state or community. Simply changing management (improving grazing management or controlling brush) cannot create sufficient change to restore the site within a reasonable time frame.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1500	2400	3000
Shrub/Vine	750	1200	1500
Forb	250	400	500
Total	**2500**	**4000**	**5000**

Pathway 1.1A
Community 1.1 to 1.2

Tallgrass Savannah

Midgrass Savannah

The Tallgrass Savannah Community (1.1) requires fire and/or brush control to maintain woody species cover below 20 percent. This community will shift to the Midgrass Savannah Community (1.2) when there is continued growing season stress on tallgrasses. These stresses include improper grazing management that creates insufficient critical growing season deferment, excess intensity of defoliation, repeated, long-term growing season defoliation, and long-term drought. Increaser species (midgrasses and woody species) are generally endemic species released by disturbance. Woody species canopy exceeding 20 percent and/or dominance of tallgrasses falling below 50 percent of species composition indicate a transition to the Midgrass Savannah Community. The Tallgrass Savannah Community can be maintained through the implementation of brush management combined with properly managed grazing that provides adequate growing season deferment to allow establishment of tallgrass propagules and/or the recovery of vigor of stressed plants. Regardless of grazing management, without some form of brush control, the Tallgrass Savannah Community will transition to the Woodland State even if the understory component does not shift to dominance by midgrasses. The driver for community shift 1.1A for the herbaceous component is improper grazing management, while the driver for the woody component is lack of fire and/or brush control.

Pathway 1.2A
Community 1.2 to 1.1

Midgrass Savannah

Tallgrass Savannah

The Midgrass Savannah Community (1.2) will return to the Tallgrass Savannah Community (1.1) with brush control and proper grazing management that provides sufficient critical growing season deferment in combination with proper grazing intensity. Favorable moisture conditions will facilitate or accelerate this transition. The understory component may return to dominance by tallgrasses in the absence of fire (at least until shrub canopy cover reaches 50 percent). Reduction of the woody component will require inputs of fire and/or brush control. The understory and overstory components can act independently when canopy cover is less than 50 percent, meaning, an increase in shrub canopy cover can occur while proper grazing management creates an increase in desirable herbaceous species. The driver for community shift 1.2A for the herbaceous component is proper grazing management, while the driver for the woody component is fire and/or brush control.

State 2
Woodland

Only one community is in the Woodland State, the 2.1 Dense woodland Community. Community 2.1 is characterized by cool-season and shade-tolerate grasses dominating the understory. Woody species occupy greater than 50 percent of the overstory.

Community 2.1
Dense Woodland

The Dense Woodland Community (2.1) has over 50 percent woody plant canopy, dominated by hardwoods such as pecan and oaks. The community 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. Annual herbage production decreases due to a decline in soil structure and organic matter. Production of the overstory canopy has increased by a similar amount to the decrease in herbaceous production. All unpalatable woody species have increased in size and density. Common understory and midstory species that grow under a dense canopy include the following grasses and grasslikes: Panicums, paspalums, tridens (Tridens spp.), woodoats, wildryes, Texas wintergrass, bristlegrass (Setaria spp.), sedges, flatsedges (Cyperus spp.) rushes (Juncus spp.), and fimbry (Fimbristylis spp.). Forbs include: western ragweed (*Ambrosia psilostachya*), blood ragweed (*Ambrosia trifida* var. texana), sumpweed (*Iva angustifolia*), cocklebur, mare’s tail (Equisetum spp.), and cattail (*Typha latifolia*). Trees, shrubs, and vines include: Elm (Ulmus spp.), bumelia (*Sideroxylon lanuginosum*), sumacs (Rhus spp.), hawthorn (Crataegus spp.), buttonbush (*Cephalanthus occidentalis*), grape (Vitis spp.), greenbriar (Smilax spp.), and ivy treebine (Cissus incisa). Texas wintergrass, threeawns (Aristida spp.) and annuals increase in the shade of the trees. Unpalatable invaders may occupy the interspaces between trees and shrubs. Plant vigor and productivity of grass species is reduced due to shade. Shade is a driving factor for the understory plant community. Without brush control, tree canopy will continue to increase until canopy cover approaches 80 percent. In this plant community, annual production is dominated by woody species. Browsing animals such as goats and deer can find fair food value if browse plants have not been grazed excessively. Forage quantity and quality for cattle is low. Prescribed fire is not a viable treatment option for conversion of this site back to a semblance of the Tallgrass Savannah Community. Chemical brush control on a large scale may not a treatment option; however, individual plant treatment with herbicides on small acreages may be a viable option. Mechanical treatment of this site, along with seeding, is the most viable treatment option although it may not be economical.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	2800	4000	5600
Grass/Grasslike	350	550	700
Forb	350	550	700
Total	**3500**	**5100**	**7000**

State 3
Converted Land

Two communities exist in the Converted State: 3.1 Converted Land Community and the 3.2 Abandoned Land Community. The 3.1 Community is characterized by agricultural production. The site may be planted to improved pasture for hay or grazing. The site may otherwise be planted to row crops. The 3.2 community represents an agricultural state that has not been managed. The land is colonized by first successional species.

Community 3.1
Converted Land

The Converted Land Community (3.1) occurs when the site, either the Savannah State (1) or Woodland State (2), is cleared and plowed for planting to cropland, hayland, native grasses, tame pasture, or use as non-agricultural land. The Converted State includes cropland, tame pasture, hayland, rangeland, and go-back land. Agronomic practices are used with non-native forages in the Converted State and to make changes between the communities in the Converted State. The native component of the prairie 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. The Loamy Bottomland site is frequently converted to cropland or tame pasture sites because of its deep fertile soils, favorable soil/water/plant relationship, and level terrain. Hundreds of thousands of acres have been plowed up and converted to cropland, pastureland, or hayland. Small grains are the principal crop, and Bermudagrass is the primary introduced pasture species on loamy soils in this area. The Loamy Bottomland site can be an extremely productive forage producing site with the application of optimum amounts of fertilizer. Cropland, pastureland, and hayland are intensively managed with annual cultivation and/or frequent use of herbicides, pesticides, and commercial fertilizers to increase production. Both crop and pasturelands require weed and shrub control because seeds remain present on the site, either by remaining in the soil or being transported to the site. Converted sites require continual fertilization for crops or tame pasture (particularly Bermudagrass) to perform well. Common introduced species include coastal Bermudagrass, kleingrass, and Old World bluestems (Bothriochloa spp.) which are used in hayland and tame pastures. Wheat, oats, forage sorghum, grain sorghum, cotton, and corn are the major crop species. Cropland and tame pasture require repeated and continual inputs of fertilizer and weed control to maintain the Converted State. Without agronomic inputs, the site will eventually return to either the Savannah or Woodland state. The site is considered go-back land during the period between active management for pasture or cropland and the return to a native state.

Community 3.2
Abandoned Land

The Abandoned Land Community (3.2) occurs when the Converted Land Community (3.1) abandoned or mismanaged. Mismanagement can include poor crop or haying management. Pastureland can transition to the Abandoned Land Community when subjected to improper grazing management (typically long-term overgrazing). Heavily disturbed soils allowed to “go-back” return to the Woodland State. These sites may become an eastern red cedar brake over time. Long-term cropping can create changes in soil chemistry and structure that make restoration to the reference state very difficult and/or expensive. Return to native prairie communities in the Savannah State is more likely to be successful if soil chemistry, microorganisms, and structure are not heavily disturbed. Preservation of favorable soil microbes increases the likelihood of a return to reference (or near reference) conditions. Restoration to native prairie will require seedbed preparation and seeding of native species. Protocols and plant materials for restoring prairie communities is a developing portion of restoration science. Sites can be restored to the Savannah State in the short-term by seeding mixtures of commercially-available native grasses. With proper management (prescribed grazing, weed control, brush control) these sites can come close to the diversity and complexity of Tallgrass Savannah Community (1.1). It is unlikely that abandoned farmland will return to the Savannah State without active brush management because the rate of shrub increase will exceed the rate of recovery by desirable grass species. Without active restoration the site is not likely to return to reference conditions due to the introduction of introduced forbs and grasses. The native component of the prairie 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.

Pathway 3.1A
Community 3.1 to 3.2

The Converted Land Community (3.1) will transition to the Abandoned Land Community (3.2) if improperly managed as cropland, hayland, or pastureland. Each of these types of converted land is unstable and requires constant management input for maintenance or improvement. This community requires inputs of tillage, weed management, brush control, fertilizer, and reseeding of annual crops. The driver of this transition is the lack of management inputs necessary to maintain cropland, hayland, or pastureland.

Pathway 3.2A
Community 3.2 to 3.1

The Abandoned Land Community (3.2) will transition to the Converted Land Community (3.1) with proper management inputs. The drivers for this transition are weed control, brush control, tillage, proper grazing management, and range or pasture planting.

Transition T1A
State 1 to 2

Shrubs and trees make up a portion of the plant community in the Savannah State, hence woody propagules are present. Therefore, the Savannah State is always at risk for shrub dominance and the transition to the Woodland State in the absence of fire. The driver for Transition T1A is lack of fire and/or brush control. The mean fire return interval in the Savannah State is two to five years. Most fires will burn only the understory. Even with proper grazing and favorable climate conditions, lack of fire for 8 to 15 years will allow trees and shrubs to increase in canopy to reach the 50 percent threshold level. The introduction of aggressive woody invader species increases the risk and accelerates the rate at which this transition state is likely to occur. This transition can occur from any community within the Savannah State, it is not dependent on degradation of the herbaceous community, but on the lack of some form of brush control. Improper grazing and prolonged drought will provide a competitive advantage to shrubs which will accelerate this process. Tallgrasses will decrease to less than five percent species composition.

Transition T1B
State 1 to 3

The transition to the Converted State from either the Savannah State is plowed for planting to cropland or hayland. The size and density of brush will require heavy equipment and energy-intensive practices (i.e. rootplowing, raking, rollerchopping, or heavy disking) to prepare a seedbed. The threshold for this transition is the plowing of the prairie soil and removal of the prairie plant community. The Converted State includes cropland, tame pasture, and go-back land. The site is considered “go-back land” during the period between cessation of active cropping, fertilization, and weed control and the return to the “native” states. Agronomic practices are used to convert rangeland to the Converted State and to make changes between the communities in the Converted State. The driver for these transitions is management’s decision to farm the site.

Restoration pathway R2A
State 2 to 1

Restoration of the Woodland State to the Savannah State requires substantial energy input. The driver for this restoration pathway is removal of invasive woody species, restoration of native herbaceous and overstory species, and ongoing management of invasives. Without maintenance, invasive species are likely to return (probably rapidly) due to presence of propagules in the soil.

Transition T2A
State 2 to 3

The transition to the Converted State from the Woodland State (T2A) occurs when the Savannah is plowed for planting to cropland or hayland. The size and density of brush in the Woodland State will require heavy equipment and energy-intensive practices (i.e. rootplowing, raking, rollerchopping, or heavy disking) to prepare a seedbed. The threshold for this transition is the plowing of the prairie soil and removal of the prairie plant community. The Converted State includes cropland, tame pasture, and go-back land. The site is considered “go-back land” during the period between cessation of active cropping, fertilization, and weed control and the return to the “native” states. Agronomic practices are used to convert rangeland to the Converted State and to make changes between the communities in the Converted State. The driver for these transitions is management's decision to farm the site.

Restoration pathway R3A
State 3 to 1

Restoration from the Converted State can occur in the short-term through active restoration or over the long-term due to cessation of agronomic practices. Cropland and tame pasture require repeated and continual inputs of fertilizer and weed control to maintain the Converted State. If the soil chemistry and structure have not been overly disturbed (which is most likely to occur with tame pasture) the site can be restored to the Savannah State. Heavily disturbed soils are more likely to return to the Woodland State. Without continued disturbance from agriculture the site can eventually return to either the Savannah or Woodland State. The level of disturbance while in the converted state determines whether the site restoration pathway is likely to be R3A (a return to the Savannah State) or T3A (a return to the Woodland State). Return to native prairie communities in the Savannah State is more likely to be successful if soil chemistry and structure are not heavily disturbed. Preservation of favorable soil microbes increases the likelihood of a return to reference conditions. Converted sites can be returned to the Savannah State through active restoration, including seedbed preparation and seeding of native grass and forb species. Protocols and plant materials for restoring prairie communities are a developing part of restoration science. The driver for both of these restoration pathways is the cessation of agricultural disturbances.

Transition T3A
State 3 to 2

Transition to the Shrubland State (2) occurs with the cessation of agronomic practices. The site will move from the Abandoned Land Community when woody species begin to invade. After shrubs and trees have established over 50 percent, and reached a height greater than three feet, the threshold has been crossed. The driver for the change is lack of agronomic inputs, improper grazing, no brush management, and no fire.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tallgrasses**			2000–4250	
	Indiangrass	SONU2	*Sorghastrum nutans*	400–1625	–
	eastern gamagrass	TRDA3	*Tripsacum dactyloides*	400–1625	–
	big bluestem	ANGE	*Andropogon gerardii*	400–1625	–
	switchgrass	PAVI2	*Panicum virgatum*	400–1500	–
	little bluestem	SCSCS	*Schizachyrium scoparium var. scoparium*	400–1500	–
2	**Tall/Midgrasses**			800–1700	
	Canada wildrye	ELCA4	*Elymus canadensis*	200–750	–
	Virginia wildrye	ELVI3	*Elymus virginicus*	200–750	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	200–750	–
	Florida paspalum	PAFL4	*Paspalum floridanum*	200–750	–
3	**Midgrasses/Grasslikes**			200–425	
	beaked panicgrass	PAAN	*Panicum anceps*	200–425	–
	rustyseed paspalum	PALA11	*Paspalum langei*	200–425	–
	panicgrass	PANIC	*Panicum*	200–425	–
	vine mesquite	PAOB	*Panicum obtusum*	200–425	–
	redtop panicgrass	PARI4	*Panicum rigidulum*	200–425	–
	gaping grass	STHI3	*Steinchisma hians*	200–425	–

	white tridens	TRAL2	*Tridens albescens*	200–425	–
	purpletop tridens	TRFL2	*Tridens flavus*	200–425	–
	longspike tridens	TRST2	*Tridens strictus*	200–425	–
	sedge	CAREX	*Carex*	100–375	–
	Indian woodoats	CHLA5	*Chasmanthium latifolium*	100–375	–
	longleaf woodoats	CHSE2	*Chasmanthium sessiliflorum*	100–375	–
	cylinder jointtail grass	COCY	*Coelorachis cylindrica*	100–375	–
	nimblewill	MUSC	*Muhlenbergia schreberi*	100–375	–
Forb					
4	**Forbs**			200–425	
	Texan great ragweed	AMTRT	*Ambrosia trifida var. texana*	200–425	–
	partridge pea	CHFA2	*Chamaecrista fasciculata*	200–425	–
	ticktrefoil	DESMO	*Desmodium*	200–425	–
	lespedeza	LESPE	*Lespedeza*	200–425	–
	dotted blazing star	LIPU	*Liatris punctata*	200–425	–
	snoutbean	RHYNC2	*Rhynchosia*	200–425	–
	fuzzybean	STROP	*Strophostyles*	200–425	–
	ironweed	VERNO	*Vernonia*	200–425	–
	white crownbeard	VEVI3	*Verbesina virginica*	200–425	–
Shrub/Vine					
5	**Shrubs/Vines/Trees**			800–1700	
	pecan	CAIL2	*Carya illinoinensis*	600–1125	–
	hackberry	CELTI	*Celtis*	600–1125	–
	American sycamore	PLOC	*Platanus occidentalis*	600–1125	–
	eastern cottonwood	PODE3	*Populus deltoides*	600–1125	–
	oak	QUERC	*Quercus*	600–1125	–
	black willow	SANI	*Salix nigra*	600–1125	–
	ash	FRAXI	*Fraxinus*	600–1125	–
	elm	ULMUS	*Ulmus*	600–1125	–
	grape	VITIS	*Vitis*	200–375	–
	honeysuckle	LONIC	*Lonicera*	200–375	–
	saw greenbrier	SMBO2	*Smilax bona-nox*	200–375	–
	hawthorn	CRATA	*Crataegus*	200–375	–
	peppervine	AMPEL3	*Ampelopsis*	200–375	–
	Alabama supplejack	BESC	*Berchemia scandens*	200–375	–

Animal community

This ecological site provides habitat which supports a resident animal community that is inhabited by white-tailed deer, Wild Turkey, and squirrels. Migratory waterfowl may use these sites if they are flooded during the late fall and winter. The riparian vegetation provides good cover for wildlife and produces browse, mast, tender grazing, and seeds for a year-round supply.

Hydrological functions

Under the Tallgrass Savannah Community (1.1), site infiltration is rapid, soil organic matter is high, soil structure is good, sediments are trapped, and porosity is high. The site will have high quality surface runoff with low erosion and sedimentation rates. During periods of heavy rainfall, the high infiltration rates will allow water to fill the soil profile. The large trees will dissipate flood energy and the root masses will bind the soil. The grasses will lie flat to also protect the soils much like the shingles on a roof. The Tallgrass Savannah Community should have no rills and no gullies present. Drainageways should be vegetated and stable. This site is often in a floodplain with occasional out-of-bank flow.

Under the Dense Woodland Community (2.1) leaf litter can build up to the point that herbaceous vegetation can be suppressed. Shading also suppresses warm season grasses. The large wood can dissipate flood energy, trap sediments, and the root masses help bind the soil. This is a stable community with no rills or gullies.

Improper grazing management reduces composition of bunchgrasses and reduces ground cover (resulting in a transition to the Midgrass Savannah Community, 1.2). This decreases the function of the water cycle: infiltration declines and runoff increases due to poor ground cover, rainfall splash, soil capping, low organic matter and poor structure. Combining sparse ground cover with intensive rainfall creates conditions that increase the frequency and severity of flooding. The decline in the quality of the understory component and the increase in shrub canopy cover cause soil erosion to accelerate, surface runoff quality to decline, and sedimentation to increase. Streambank stability will decline and erosion of waterways will increase.

In the Woodland State interception of rainfall by tree canopies increases. This reduces the amount of rainfall reaching the soil surface. The funneling effect of the canopy increases stemflow and soil moisture at tree bases. Trees have increased transpiration compared to grasses, especially evergreen species such as live oak and juniper. The increased transpiration reduces the amount of water available for other plants to use. An increase in woody canopy creates a decline in grass cover, which has similar impacts as those described for improper grazing above.

Recreational uses

Recreational uses include recreational hunting, hiking, camping, equestrian, and bird watching.

Wood products

Hardwoods are used for posts, firewood, charcoal, and other specialty wood products.

Other products

Jams and jellies are made from many fruit-bearing species, such as and wild grape. Seeds are harvested from many reference plants for commercial sale. Many grasses and forbs are harvested by the dried-plant industry for sale in dried flower arrangements. Honeybees are utilized to harvest honey from many flowering plants. This is a very good site for pecan production.

Inventory data references

These site descriptions were developed as part a Provisional Ecological Site project using historic soil survey manuscripts, available site descriptions, and low intensity field traverse sampling. Future work to validate the information is needed. This will include field activities to collect low, medium, and high-intensity sampling, soil correlations, and analysis of that data. A final field review, peer review, quality control, and quality assurance review of the will be needed to produce the final document.

Other references

1. Archer, S. 1994. Woody plant encroachment into southwestern grasslands and savannas: rates, patterns and proximate causes. In: Ecological implications of livestock herbivory in the West, pp. 13-68. Edited by M. Vavra, W. Laycock, R. Pieper. Society for Range Management Publication, Denver, CO.
2. Archer, S. and F.E. Smeins. 1991. Ecosystem-level Processes. Chapter 5 in: Grazing Management: An Ecological Perspective. Edited by R.K. Heitschmidt and J.W. Stuth. Timber Press, Portland, OR.

3. Bestelmeyer, B.T., J.R. Brown, K.M. Havstad, R. Alexander, G. Chavez, and J.E. Herrick. 2003. Development and use of state-and-transition models for rangelands. J. Range Manage. 56(2): 114-126.
4. Brown, J.R. and S. Archer. 1999. Shrub invasion of grassland: recruitment is continuous and not regulated by herbaceous biomass or density. Ecology 80(7): 2385-2396.
5. Foster, J.H. 1917. Pre-settlement fire frequency regions of the United States: a first approximation. Tall Timbers Fire Ecology Conference Proceedings No. 20.
6. Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press, College Station, TX. 653p.
7. Hamilton, W. and D. Ueckert. 2005. Rangeland Woody Plant Control: Past, Present, and Future. Chapter 1 in: Brush Management: Past, Present, and Future. pp. 3-16. Texas A&M University Press.
8. Mann, C. 2004. 1491. New Revelations of the Americas before Columbus.
9. Scifres, C.J. and W.T. Hamilton. 1993. Prescribed Burning for Brush Management: The South Texas Example. Texas A&M University Press, College Station, TX. 245 p.
10. Smeins, F., S. Fuhlendorf, and C. Taylor, Jr. 1997. Environmental and Land Use Changes: A Long Term Perspective. Chapter 1 in: Juniper Symposium 1997, pp. 1-21. Texas Agricultural Experiment Station.
11. Stringham, T.K., W.C. Krueger, and P.L. Shaver. 2001. State and transition modeling: and ecological process approach. J. Range Manage. 56(2):106-113.
12. Texas Agriculture Experiment Station. 2007. Benny Simpson's Texas Native Trees (http://aggie-horticulture.tamu.edu/ornamentals/natives/).
13. Texas A&M Research and Extension Center. 2000. Native Plants of South Texas (http://uvalde.tamu.edu/herbarium/index.html).
14. Thurow, T.L. 1991. Hydrology and Erosion. Chapter 6 in: Grazing Management: An Ecological Perspective. Edited by R.K. Heitschmidt and J.W. Stuth. Timber Press, Portland, OR.
15. TR 1737-15 (1998) Riparian Area Management – a users Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. Bureau of Land Management, US Forest Service, Natural Resources Conservation Service.
16. USDA/NRCS Soil Survey Manuals for appropriate counties within MLRA 86A.
17. USDA, NRCS. 1997. National Range and Pasture Handbook.
18. USDA, NRCS. 2007. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
19. Vines, R.A. 1984. Trees of Central Texas. University of Texas Press, Austin, TX.
20. Vines, R.A. 1977. Trees of Eastern Texas. University of Texas Press, Austin, TX. 538 p.
21. Wright, H.A. and A.W. Bailey. 1982. Fire Ecology: United States and Southern Canada. John Wiley & Sons, Inc.

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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)	Lem Creswell, RMS, NRCS, Weatherford, Texas
Contact for lead author	817-596-2865
Date	06/01/2005
Approved by	Bryan Christensen
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:** Water flow patterns are common and follow old stream meanders. Deposition or erosion is uncommon for normal rainfall but may occur during intense rainfall events.

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Essentially none. Site has litter filling interspaces between plant bases.

5. **Number of gullies and erosion associated with gullies:** No gullies should be present on side drains into perennial or intermittent streams. Drainageways should be vegetated and stable.

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

7. **Amount of litter movement (describe size and distance expected to travel):** This site is a floodplain with occasional out of bank flow. Under normal rainfall, little litter movement should be expected; however, litter of all sizes may move long distances due to obstructions during high flows.

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 erosion. Stability class ranges expected to be 4 to 6.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 0 to 9 inches thick with colors from reddish brown silty clay loam to dark grayish brown loams and generally weak fine and medium subangular blocky structure. SOM is 0.5 to 3 percent.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Under reference conditions, this bottomland site is dominated by tall grasses and forbs having adequate litter and little bare ground and provides for maximum infiltration and little runoff under normal rainfall events.

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: Cool-season grasses >> Warm-season midgrasses > Trees

    Other: Forbs > Shrubs/Vines

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Grasses, trees, and forbs due to their growth habit will exhibit some mortality and decadence, though very slight due to long-lived nature of plants. Open spaces from disturbance are quickly filled by new plants through seedlings and vegetative reproduction (tillering).

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 4,000 to 8,500 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:** Yellow bluestems, common Bermudagrass, mesquite, elms, huisache, eastern red cedar, osage orange, Chinese tallow.

17. **Perennial plant reproductive capability:** All perennial plants should be capable of reproducing except during periods of prolonged drought conditions, heavy natural herbivory, prolonged flooding, or intense wildfires.