USDA Natural Resources Conservation Service

Ecological site R086AY002TX
Southern Chalky Ridge

Last updated: 9/21/2023
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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.

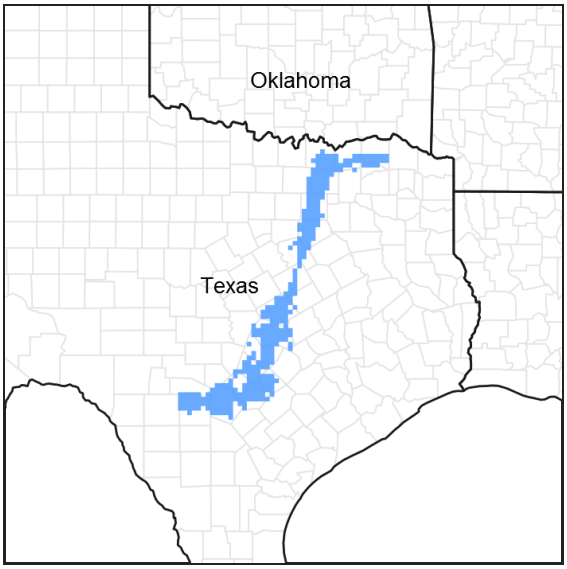


Figure 1. Mapped extent

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): 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 major thoroughfare for commerce and travel, traverses the length of the MLRA from San Antonio to Dallas. The area supports tall and midgrass 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 Chalky Ridge site is a true tallgrass prairie. The sites are characterized by very shallow to moderately deep soils that are high in calcium carbonate.

Associated sites

R086AY007TX	**Southern Clay Loam** The Clay Loam site is often downslope from the Chalky Ridge site. It differs from the site by having deeper soils, higher soil fertility, low to moderate runoff, and lower erosion rates.
R086AY011TX	**Southern Blackland** The Blackland site is often downslope from the Chalky Ridge site. It differs from the site by having deeper soils, higher soil fertility, and higher soil clay content.

Similar sites

R086AY001TX	**Northern Chalky Ridge** The Northern Chalky Ridge site is similar to the Southern Chalky Ridge site by having similar physiographic features and representative soil features. It differs from the site by receiving more effective precipitation.
R086BY001TX	**Chalky Ridge** Similar but different MLRA.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Sorghastrum nutans*

Physiographic features

These are nearly level to moderately steep soils on uplands and terraces. The slope gradients range from 0 to 20 percent but are usually less than 8 percent. Some sites flood, but only rarely. Runoff is low to medium.

Table 2. Representative physiographic features

Landforms	(1) Plains > Ridge (2) Plains > Paleoterrace
Runoff class	Low to medium
Flooding frequency	None to rare
Ponding frequency	None
Elevation	122–305 m
Slope	0–8%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–20%

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 4. Representative climatic features

Frost-free period (average)	244 days
Freeze-free period (average)	276 days
Precipitation total (average)	914 mm

Climate stations used

- (1) CEDAR CREEK 5 S [USC00411541], Cedar Creek, TX
- (2) RED ROCK [USC00417497], Red Rock, TX
- (3) TAYLOR 1NW [USC00418862], Taylor, TX
- (4) WACO DAM [USC00419417], Waco, TX
- (5) CAMERON [USC00411348], Cameron, TX
- (6) LULING [USC00415429], Luling, TX
- (7) TEMPLE [USC00418910], Temple, TX
- (8) NEW BRAUNFELS [USC00416276], New Braunfels, TX
- (9) SAN ANTONIO 8NNE [USC00417947], San Antonio, TX
- (10) SAN MARCOS [USC00417983], San Marcos, TX
- (11) AUSTIN-CAMP MABRY [USW00013958], Austin, TX
- (12) GRANGER DAM [USC00413686], Granger, TX
- (13) SAN ANTONIO INTL AP [USW00012921], San Antonio, TX
- (14) AUSTIN BERGSTROM AP [USW00013904], Austin, TX

Influencing water features

A stream does not influence the plant communities of this site.

Wetland description

Wetlands are not associated with this site.

Soil features

The site consists of very shallow to moderately deep, well drained soils that are very slowly to moderately slowly permeability. The upland soils were formed in calcareous chalk and the terrace soils were formed in gravelly, clayey, and sandy alluvial sediments. In a representative profile the surface layer is light brownish gray, gravelly clay loam about 10 inches thick. Below 10 inches and to depths of more than 60 inches, the parent material is calcareous chalk. Available water capacity to a depth of 60 inches is very low.

The associated soil series for the Chalky Ridge are: Castephen, Doss, Eddy, Howe, Patrick, Queeny, Quihi, Stephen, and Whitewright.

Table 5. Representative soil features

Parent material	(1) Residuum–limestone (2) Alluvium–sandstone
Surface texture	(1) Gravelly clay loam (2) Silty clay loam (3) Silty clay
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to moderately slow
Soil depth	8–97 cm
Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0–10%
Available water capacity (0-101.6cm)	0.76–13.21 cm
Calcium carbonate equivalent (0-101.6cm)	10–80%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.9–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–35%
Subsurface fragment volume >3" (Depth not specified)	0–70%

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.

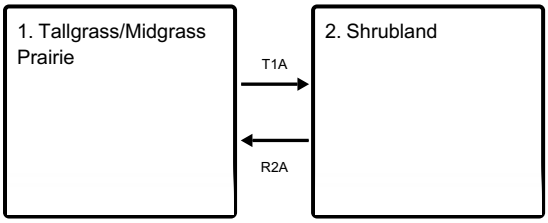
Introduced pasture has been established on many acres of old cropland and in areas with deeper soils. Coastal bermudagrass (*Cynodon dactylon*) and kleingrass (*Panicum coloratum*) are by far the most frequently used introduced grasses for forage and hay. Hay has also been harvested from a majority of 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

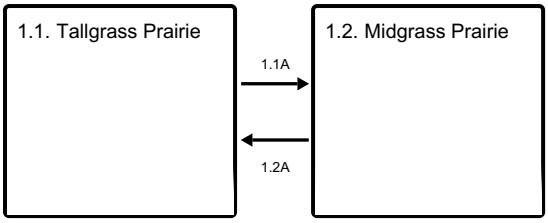
Ecosystem states



T1A - No fire, no brush control, improper grazing management, long-term drought or growing-season stress

R2A - Fire, brush management, proper grazing

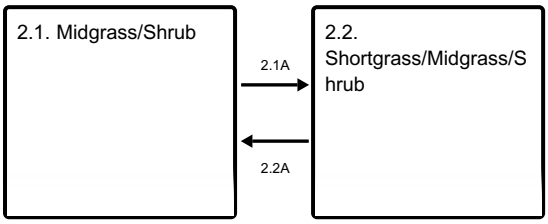
State 1 submodel, plant communities



1.1A - No fire, no brush control, improper grazing management, long-term drought or growing-season stress

1.2A - Fire, brush management, proper grazing

State 2 submodel, plant communities



2.1A - No fire, no brush control, severe drought

2.2A - Fire and brush management

State 1
Tallgrass/Midgrass Prairie

Two communities exist in the Tallgrass/Midgrass State: the 1.1 Tallgrass Prairie Community and the 1.2 Midgrass Plant Community. Community 1.1 is characterized by tallgrasses dominating the understory annual production and woody species cover less than 15 percent of the area. Community 1.2 is characterized by midgrass dominance, but the woody species cover is 15 to 25 percent, with some species attaining heights of three feet.

Community 1.1
Tallgrass Prairie

The Tallgrass Prairie Community (1.1) is the reference community and is characterized as a tallgrass prairie with scattered trees and low-growing shrubs as well as a diverse population of perennial forbs. Little bluestem dominates the herbaceous component of the site. Other important grasses are Indiangrass, big bluestem, sideoats grama, Texas wintergrass, silver bluestem (*Bothriochloa laguroides*), dropseeds, hairy grama (*Bouteloua hirsuta*), slim tridens (*Tridens muticus* var. muticus), rough tridens (*Tridens muticus* var. elongatus), buffalograss (*Bouteloua dactyloides*), and curlymesquite (*Hilaria belangeri*). A wide variety of forbs is commonly found on the site, including Maximilian sunflower (*Helianthus maximiliani*), awnless bushsunflower (*Simsia calva*), Engelmann's daisy (*Engelmannia peristenia*), dotted gayfeather (*Liatris punctata*), halfshrub sundrop (*Calylophus berlandieri*),

bundleflowers (Desmanthus spp.), and many others. Scattered shrub and tree species found in the reference community (1.1) include live oak, hackberry, elm (Ulmus spp.), bumelia (*Sideroxylon lanuginosum*) skunkbush sumac (*Rhus aromatica*), and agarito (*Mahonia trifoliolata*). The reference Tallgrass Prairie Community (1.1) will transition to the Midgrass Prairie Community (1.2) with lack of fire, lack of brush control, long-term drought, repeated, long-term growing-season defoliation, and/or other repeated critical growing-season stress. The first species to decrease in dominance will be the grasses and forbs with the least tolerance for disturbance and highest moisture requirements (i.e. Indiangrass, big bluestem, and Engelmann's daisy). This will initially result in an increase in composition of little bluestem. As shrub canopy cover increases, little bluestem will decrease and shade and drought tolerant midgrasses and forbs will increase in composition.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1793	2690	3587
Forb	224	336	448
Shrub/Vine	224	336	448
Total	**2241**	**3362**	**4483**

Community 1.2
Midgrass Prairie

The Midgrass Prairie Community (1.2) typically results from long-term improper grazing management and/or lack of fire over a long period of time (transition 1.1A). During this period, indigenous or invading woody species increase on the site. The site will return to the Tallgrass Prairie Community (1.1) when brush management combined with proper grazing management allows competition from a vigorous grass component to dominate open areas while shrubs dominate mottes and constitute 15 percent or less woody canopy cover (transition 1.2A). When the Midgrass Prairie Community (1.2) is continually overgrazed and fire is excluded, the community crosses a threshold (T1A) to a state that is dominated by woody plants, the Midgrass/Shrub Community (2.1). Important grasses are little bluestem, sideoats grama, silver bluestem, tall dropseed (*Sporobolus compositus*), and Texas cupgrass (*Eriochloa sericea*). More grazing-resistant shortgrasses and less palatable forbs begin replacing the midgrasses. Some of the reference perennial forbs persist, but less palatable forbs will increase. Woody canopy is more than 15 percent. Numerous shrub and tree species will continue to increase because shrub canopy intercepts rainfall and creates drier growing conditions for understory species, reducing their vigor and competitiveness. Typically, trees such as oak, elm, hackberry, and ash (Fraxinus spp.) will increase in size, while other tree and shrub species such as bumelia, sumac, elbowbush (*Forestiera pubescens*), agarito, honey mesquite (*Prosopis glandulosa*), juniper, and pricklypear (Opuntia spp.) will increase in density. To control woody species populations, prescribed grazing (browsing) and fire can be used to control smaller shrubs and trees. Mechanical removal of larger shrubs and trees may be necessary in older stands. The time frame for woody species to dominate a healthy community is not precisely known, but indications are that re-growth of woody species reached 75 percent canopy cover in about 25 years. Fire and brush management are difficult to use on this site. Examples exist of restoration using strategic burning with small fires. Chemical control may require hand spraying or aerial application to create openings in a closed shrub canopy. It may take several years to achieve change, depending upon growing conditions and the

aggressiveness of treatment. Large scale prescribed fires require careful fuel management and generally involve burning this site at the same time as surrounding more productive sites with plentiful fine fuels. The transition 1.1A will result in an increase in bare ground, shrub density, and length of water flow patterns, in addition to decreased infiltration. Heavy continuous grazing will reduce plant cover, litter, and mulch. Litter and mulch will move off site as plant cover declines. Ashe juniper (*Juniperus ashei*) is a particularly aggressive shrub on this site. Once the midgrasses decrease below 25 percent of composition, woody species exceeds 25 percent canopy cover, and the woody plants within the grassland portion of the site reach fire-resistant size (about three feet in height), the site crosses a threshold into the Shrubland State (2) and the Midgrass/Shrub Plant Community (2.1). Until the Midgrass Prairie Community (1.2) crosses the threshold (T1A) into the Midgrass/Shrub Community (2.1), this community can be managed back toward the reference community (1.1) through the use of cultural practices including strategic burning and strategic brush management. Once invasive woody species become established, returning fully to the reference is difficult, but it is possible to return to a similarly functioning plant community. The risk of soil erosion under shrub canopy is much less than deeper sites due to shallow soil depths. The large fragments that cover 35 to 65 percent of the soil surface provide numerous interruptions to waterflow that reduces the opportunity for soil to flow off site. Unlike sites with deeper soils, changing management practices (brush control combined with proper grazing management) can create sufficient change in growing conditions for the site to follow restoration pathway R2A to the Tallgrass/Midgrass/Prairie State within a reasonable time frame.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	538	897	1211
Grass/Grasslike	538	897	1211
Forb	269	448	605
Total	**1345**	**2242**	**3027**

Pathway 1.1A
Community 1.1 to 1.2

Tallgrass Prairie **Midgrass Prairie**

The Tallgrass Prairie Community (1.1) will shift to the Midgrass Prairie Community (1.2) when there is continued growing season stress on reference grass species. These stresses include lack of fire, lack of brush management, long-term drought and/or other repeated critical growing season stress. Increaser species (lower successional midgrasses, shortgrasses, and woody species) are generally endemic species released from competition as vigor of tallgrasses declines. Woody species canopy exceeding 15 percent and/or dominance of tallgrasses falling below 50 percent of species composition indicate a shift to the Midgrass Prairie Community. Pre-settlement, the reference community was dependent on fire to maintain the prairie's balance of grass and shrubs. Currently, fire and/or brush management are required to maintain the reference community. Due to the infrequent and irregular nature of fire pre-settlement, one can theorize the site shifted between the two communities within the Tallgrass/Midgrass Prairie State. The site may have may have crossed the threshold to the Shrubland State, even under natural influences in some cases. This site would be less stable than the surrounding sites. The driver for community shift 1.1A can either be improper grazing or not enough grazing, leading to increased competition from invader midgrasses, forbs, and shrubs. Increasing canopy cover of woody species due to lack of fire and/or brush control will drive woody cover towards the Midgrass Prairie Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Midgrass Prairie

Tallgrass Prairie

The Midgrass Prairie Community (1.2) will return to the Tallgrass Prairie Community (1.1) under 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. However, reduction of the woody component to reference conditions of 15 percent or less canopy cover will require inputs of fire and/or brush control. Due to the shallow soils of the site, brush management may be limited to hand work or chemical control using aerial or all-terrain vehicle (ATV) application because site conditions may not favor use of heavy machinery. The driver for community shift 1.2A for the herbaceous component is improper grazing management. The driver for the woody component is lack of fire and/or brush control. Brush management can also benefit tallgrasses and drive community shift 1.2A for the herbaceous community.

State 2
Shrubland

Two communities exist in the Shrubland State: the 2.1 Midgrass/Shrub Community and the 2.2 Shortgrass/Midgrass/Shrub Community. Community 2.1 is characterized by midgrasses dominating the understory annual production and woody species between 25 and 40 percent. Community 2.2 is characterized by shortgrass dominance, but the woody species cover is greater than 40 percent.

Community 2.1
Midgrass/Shrub

The Midgrass/Shrub Community (2.1) has less than 40 percent woody plant canopy, with honey mesquite and juniper invading the former grassland areas. The community loses its prairie appearance with invasive shrubs beginning to fill the open grassland portion of the site. This community type is the result of lack of fire and accompanying increase in shrub canopy cover. Dense juniper stands are commonly referred to locally as “old growth cedar” or “cedar breaks”. These juniper stands can occur in either the Midgrass/Shrub community (2.1) or Midgrass/Shortgrass/Shrub community (2.2) depending on the composition of the understory. Canopy cover of these juniper stands can reach 80 percent if left unchecked. Sideoats grama and other reference (1.1) midgrasses decrease to the point that grasses no longer form the dominant component. Shortgrasses such as low panicums (Panicum spp.) and threeawns (Aristida spp.) increase. Remnants of the historic grasses and forbs along with lower successional grasses and forbs are often protected under the canopies or between rocks. Cool-season species such as Texas wintergrass and sedges (Carex spp.) can be found under and around woody plants. Plant vigor and productivity of the grassland component is reduced due to competition for nutrients and water from woody plants. Common herbaceous species include tall grama, and Mexican sagewort (*Artemisia ludoviciana* ssp. mexicana). Buffalograss, western ragweed (*Ambrosia psilostachya*), and curlymesquite are persistent increasers until shrub density reaches maximum canopy. Once juniper stands have become dense and extensive, it is difficult to establish

other woody species. Although difficult, managers can restore the grassland openings within the shrubs through properly executed brush management. The degree of treatment depends upon practicality. The success of reestablishment of desirable native grasses and forbs is dependant upon soil being left when juniper is removed. Brush removal that leaves the thin layer of soil can increase the likelihood of success of reseeding efforts. Reclamation success is often dependant on the skill of those removing brush. The slope of this site makes restoration a difficult practice and often limits the size of restoration operations. As the grassland vegetation declines, more soil is exposed, leading to crusting and erosion. Higher rainfall interception losses by the increasing woody canopy combined with increased evaporation and runoff can reduce the effectiveness of rainfall. Soil organic matter and soil structure decline within the interspaces, but soil conditions improve under the woody plant cover. Soil loss can occur during rainfall events. Unless brush management and proper grazing management are applied at this stage, understory composition will continue to shift towards shortgrasses and unpalatable forbs, causing the community to convert to the Shortgrass/Midgrass/Shrub Community (2.2). Aggressive shrubs (such as juniper) can facilitate this shift even under proper grazing management. Excessive grazing by deer or goats will create a community dominated by large trees. Few remnant midgrasses and opportunistic shortgrasses, annuals, and perennial forbs occupy the woody plant interspaces. Characteristic grasses are threeawns and cedar sedge (*Carex planostachys*). Grasses and forbs make up as little as five percent of annual biomass production. Excessive cattle grazing tends to create a different response and structure to the community than does excessive deer or goat grazing. Unrestricted cattle grazing tends to accelerate invasion of shrubs because all shrubs invade the site and gain competitive advantage over herbaceous species. Excess deer or goat browsing tends to create a dominance of large trees by removing both young shrubs and the young growth that grows below the browse line on larger shrubs and trees. While large trees will continue to increase in size, they will have very little production below the browse line, creating a park-like look. The site becomes dominated by large trees with little forage available for livestock or wildlife. Large trees with little understory provide much less soil protection than do dense stands of grass. As soils erode, understory species have reduced potential to revegetate the site. The bare area under the browse line creates a situation that provides poor forage conditions and poor visual cover for wildlife.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	392	560	1121
Grass/Grasslike	275	392	785
Forb	118	168	336
Total	**785**	**1120**	**2242**

Community 2.2
Shortgrass/Midgrass/Shrub

The Shortgrass/Midgrass/Shrub Community (2.2) is the result of many years of improper grazing management, lack of periodic fires, and/or lack of proper brush management. Oaks, honey mesquite, and/or juniper dominate the Shortgrass/Midgrass/Shrub Community (2.2), which has greater than 40 percent woody canopy cover and little or low understory production. It is now essentially a shrubland with remnant grasses, sedges, and forbs under the canopy and within interspaces. As brush canopy increases, annual production for the understory declines to very

low levels, due to shading, competition for nutrients, and interception of rainfall by the shrub canopy. Most of the remaining understory is shade tolerant, grazing tolerant, and/or unpalatable. Common understory shrubs are pricklypear, yucca, agarito, and sumacs. Grazing pressure generally becomes less of a factor once the community has reached this stage, particularly if junipers have replaced shrubs with browsing value. Canopy cover will increase until the site is covered with a dense stand of brush. Reference sites demonstrate that the Chalky Ridge site is highly resilient when brush control is accompanied by favorable growing conditions. Because soils on this site are shallow to very shallow even in historic conditions, erosion is not severe under shrub canopy. If remnant plants are present, tallgrasses such as big bluestem, little bluestem, and Indiangrass reestablish and increase following brush control or fire accompanied by grazing deferment. Remnant grasses are protected between the rocks so that once the overstory is removed, they can express themselves. Cleared sites frequently re-grow to dense juniper stands that can reach 75 percent cover in less than 25 years unless juniper control measures are taken. These dense stands of juniper can reach 80 percent canopy cover with an understory that is primarily cedar sedge with trace amounts of tallgrasses and higher successional midgrasses. The shrub canopy acts to intercept rainfall and increase evapotranspiration losses and interception losses, creating a more xeric microclimate. Soil fauna and organic mulch are reduced, exposing more of the soil surface to erosion in interspaces. The percent of exposed chalk increases with erosion. However, within the woody canopy, hydrologic processes stabilize and soil organic matter and mulch begin to increase and eventually stabilize under the shrub canopy. The Shortgrass/Midgrass/Shrub Community (2.2) provides good cover for wildlife, but only limited forage or browse is available for livestock or wildlife. At this stage, highly intensive restoration practices are needed to return the shrubland to grassland. Alternatives for restoration include brush control and range planting, proper stocking, prescribed grazing, and prescribed burning following restoration to maintain the desired community.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	314	549	785
Grass/Grasslike	67	118	168
Forb	67	118	168
Total	**448**	**785**	**1121**

Pathway 2.1A
Community 2.1 to 2.2

Midgrass/Shrub **Shortgrass/Midgrass/Shrub**

Without fire (natural or human-caused) and/or brush management, woody density and canopy cover will increase in the Midgrass/Shrub Community (2.1) until it converts into the Shortgrass/Midgrass/Shrub Community (2.2). Improper grazing management and/or long-term drought (or other growing-season stress) will accelerate this shift. Due to the shallow nature of the soils, woody species (particularly live oak and juniper) may die or be seriously stressed under severe drought conditions. This may facilitate a transition back to the Tallgrass/Midgrass Prairie State by providing canopy openings for grass cover to increase when favorable growing conditions return. While woody species canopy may continue to increase, the indicator for this transition is the change of the understory from domination by midgrasses to a sparse understory of shortgrasses and unpalatable forbs. There may be areas under dense shrub cover with almost no understory. Improper grazing management or other long-term growing-season stress can decrease the composition of midgrasses and palatable forbs in the herbaceous component. Even without grazing, in the absence of fire, the woody component will increase to the point that the herbaceous component will shift in composition toward shortgrasses and forbs more suited to growing in shaded conditions with little available soil moisture. The driver for community shift 2.1A is lack of fire and/or brush management.

Pathway 2.2A
Community 2.2 to 2.1

Shortgrass/Midgrass/Shrub

Midgrass/Shrub

Brush management and/or fire can create great openings in the canopy so that remnant midgrasses and shade intolerant forbs can increase in vigor and composition. Large populations of forbs may remain with stands of herbaceous growth in the openings of shrub canopy. Continued fire and/or brush management will be required to maintain openings in the canopy. Fire is limited on steeper slopes due to sparse grass fuel. This site is usually burned along with adjacent ecological sites. If the herbaceous component has transitioned to shortgrasses and low forbs, proper grazing management (combined with favorable moisture conditions) will be necessary to facilitate the shift of the understory component to the midgrass-dominated Midgrass/Shrub Community (2.1). Range planting may accelerate the transition of the herbaceous community, particularly when combined with favorable growing conditions. However, the shallow soils of the Chalky Ridge site make seeding somewhat risky. It is difficult to consistently establish a successful stand of seeded grasses unless done in conjunction with mechanical removal. Range planting is more commonly associated with restoration efforts associated with Restoration Pathway R2A. The driver for community shift 2.2A is fire and/or brush control.

Transition T1A
State 1 to 2

While the Tallgrass/Midgrass Prairie State has some resistance to shrub dominance, long-term lack of fire or brush management may allow brush to dominate the site even under proper grazing management. Shrubs make up a portion of the plant community in this state, therefore propagules are present. The mean fire return interval to maintain the Tallgrass/Midgrass Prairie State is 5 to 10 years. Even with proper grazing management and favorable climate conditions, lack of fire for 15 to 25 years will allow woody species to increase in canopy to reach the 25 percent threshold level. An infusion of invasive woody species (i.e. juniper or mesquite) will speed up the process. Improper grazing management, prolonged drought, and a warming climate will provide a competitive advantage to shrubs which will accelerate this process. Tallgrasses will decrease to less than 10 percent species composition. The driver for Transition T1A is lack of fire and/or brush control. The Tallgrass/Midgrass Prairie State is always at risk for the transition to the Shrubland State because woody species are present in the prairie plant community. Introduction of aggressive woody invader species (i.e. juniper) increase the risk that this state transition will occur and accelerate the rate at which it is likely to occur.

Restoration pathway R2A
State 2 to 1

Restoration of the Shrubland State to the Tallgrass/Midgrass Prairie State requires substantial energy input. Mechanical or herbicidal brush control treatments can be used to remove woody species. A long-term prescribed fire program may sufficiently reduce brush density to a level below the threshold of the Tallgrass/Midgrass Prairie State, particularly if the woody component is dominated by species that are not re-sprouters. Brush management in combination with prescribed fire, proper grazing, and favorable growing conditions may be the most economical means of creating and maintaining the desired plant community. If remnant populations of tallgrasses, midgrasses, and desirable forbs are not present at sufficient levels, range seeding will be necessary. Remnant grasses may be protected between rocks. Once the overstory is removed, they express themselves. Range planting on this site is somewhat risky, and it is a challenge to establish a successful stand of seeded grass on a consistent basis. The driver for Restoration Pathway R2A is fire and/or brush management combined with restoration of the herbaceous community and proper grazing management. Restoration may require aggressive treatment of invader species.

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tallgrasses**			1121–2242	

	little bluestem	SCSCS	*Schizachyrium scoparium var. scoparium*	1121–2242	–
2	**Tallgrasses**			336–673	
	big bluestem	ANGE	*Andropogon gerardii*	168–673	–
	Indiangrass	SONU2	*Sorghastrum nutans*	336–673	–
3	**Midgrasses**			224–448	
	sideoats grama	BOCU	*Bouteloua curtipendula*	224–448	–
	tall grama	BOHIP	*Bouteloua hirsuta var. pectinata*	224–448	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	224–448	–
	Arizona cottontop	DICA8	*Digitaria californica*	224–448	–
	Texas cupgrass	ERSE5	*Eriochloa sericea*	224–448	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	224–448	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	224–448	–
	Drummond's dropseed	SPCOD3	*Sporobolus compositus var. drummondii*	224–448	–
4	**Mid/Shortgrasses**			112–224	
	purple threeawn	ARPU9	*Aristida purpurea*	112–224	–
	Wright's threeawn	ARPUW	*Aristida purpurea var. wrightii*	112–224	–
	buffalograss	BODA2	*Bouteloua dactyloides*	112–224	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	112–224	–
	sedge	CAREX	*Carex*	112–224	–
	fall witchgrass	DICO6	*Digitaria cognata*	112–224	–
	curly-mesquite	HIBE	*Hilaria belangeri*	112–224	–
	panicgrass	PANIC	*Panicum*	112–224	–
	slim tridens	TRMUE	*Tridens muticus var. elongatus*	112–224	–
	slim tridens	TRMUM	*Tridens muticus var. muticus*	112–224	–
Forb					
5	**Forbs**			336–673	
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–224	–
	prairie false foxglove	AGHE4	*Agalinis heterophylla*	0–224	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–224	–
	white sagebrush	ARLUM2	*Artemisia ludoviciana ssp. mexicana*	0–224	–
	Berlandier's sundrops	CABE6	*Calylophus berlandieri*	0–224	–
	purple poppymallow	CAIN2	*Callirhoe involucrata*	0–224	–
	Indian paintbrush	CASTI2	*Castilleja*	0–224	–
	croton	CROTO	*Croton*	0–224	–
	prairie clover	DALEA	*Dalea*	0–224	–
	bundleflower	DESMA	*Desmanthus*	0–224	–
	ticktrefoil	DESMO	*Desmodium*	0–224	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–224	–
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	0–224	–
	snow on the prairie	EUBI2	*Euphorbia bicolor*	0–224	–
	beeblossom	GAURA	*Gaura*	0–224	

	beeblossom	GAURA	*Gaura*	0–224	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–224	–
	Chalk Hill hymenopappus	HYTE2	*Hymenopappus tenuifolius*	0–224	–
	coastal indigo	INMI	*Indigofera miniata*	0–224	–
	dotted blazing star	LIPU	*Liatris punctata*	0–224	–
	Texas lupine	LUTE	*Lupinus texensis*	0–224	–
	plains blackfoot	MELE2	*Melampodium leucanthum*	0–224	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–224	–
	yellow puff	NELU2	*Neptunia lutea*	0–224	–
	rosy palafox	PARO	*Palafoxia rosea*	0–224	–
	beardtongue	PENST	*Penstemon*	0–224	–
	scurfpea	PSORA2	*Psoralidium*	0–224	–
	snoutbean	RHYNC2	*Rhynchosia*	0–224	–
	skullcap	SCUTE	*Scutellaria*	0–224	–
	fuzzybean	STROP	*Strophostyles*	0–224	–
	vervain	VERBE	*Verbena*	0–224	–
	vetch	VICIA	*Vicia*	0–224	–
Shrub/Vine					
6	**Shrubs/Vines/Trees**			224–673	
	live oak	QUVI	*Quercus virginiana*	112–448	–
	fragrant sumac	RHAR4	*Rhus aromatica*	0–224	–
	prairie sumac	RHLA3	*Rhus lanceolata*	0–224	–
	gum bully	SILA20	*Sideroxylon lanuginosum*	0–224	–
	coralberry	SYOR	*Symphoricarpos orbiculatus*	0–224	–
	elm	ULMUS	*Ulmus*	0–224	–
	yucca	YUCCA	*Yucca*	0–224	–
	hawthorn	CRATA	*Crataegus*	0–224	–
	black prairie clover	DAFR2	*Dalea frutescens*	0–224	–
	common persimmon	DIVI5	*Diospyros virginiana*	0–224	–
	algerita	MATR3	*Mahonia trifoliolata*	0–224	–
	pricklypear	OPUNT	*Opuntia*	0–224	–
	Texas almond	PRMI2	*Prunus minutiflora*	0–224	–

Animal community

The animal community differs depending on what state the site is currently in. Northern Bobwhite prefer the reference state. They require dense bunchgrasses for nesting and cover. As the site transitions into State 2, white-tailed deer will become more prevalent. Deer are woodland and edge species, with their primary diet consisting of browse. Mourning dove need open areas with semi-clear ground and forbs with desirable seed sources. Go-back land and communities with shortgrasses and forbs provide the best habitat for dove.

Hydrological functions

Site specific information showed that in its historic state this site has no rills or gullies. This site can be very erosive in degraded states. Drainageways should be stable and covered with vegetation. Some water flow patterns are normal for this site due to landscape position and slope but should be vegetated and stable. A few slightly elevated pedestals or terracettes may occur due to slope, landscape position, and natural lack of cover on this site. Expect

no more than 10 percent bare ground randomly distributed throughout. Small to medium-size litter movement for short distances should be expected during intense rainfall events. The soil surface under reference conditions is resistant to erosion and the soil stability class range is expected to be 4 to 6. This prairie site is dominated by tallgrasses and forbs having adequate litter and little bare ground which can provide for maximum infiltration and little runoff under normal rainfall events.

Recreational uses

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

Wood products

Ashe juniper, Honey mesquite, and oak 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 agarito. Seeds are harvested from many reference community 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.

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.

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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.

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Contact for lead author	817-596-2865
Date	09/17/2007
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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2. **Presence of water flow patterns:** Some water flow patterns are normal for this site due to landscape position and

slope but should be vegetated and stable.

3. **Number and height of erosional pedestals or terracettes:** A few slightly elevated pedestals or terracettes may occur due to slope, landscape position, and natural lack of cover on this site.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect no more than 20 percent bare ground randomly distributed throughout.

5. **Number of gullies and erosion associated with gullies:** No gullies should be present. Drainageways should be stable and covered with vegetation.

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

7. **Amount of litter movement (describe size and distance expected to travel):** Small to medium-size litter movement for short distances should be expected on this site during intense rainfall events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface under reference conditions is resistant to erosion. Stability class range is expected to be 4 to 6.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface is 6 to 10 inches thick with colors of very dark brown with moderately fine to very fine subangular blocky structure. SOM is 1 to 3 percent.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** This prairie site is dominated by tallgrasses and forbs having adequate litter and little bare ground which can provide 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: Warm-season midgrasses > Forbs >

    Other: Cool-season grasses > Trees > Shrubs/Vines

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** There should be little mortality or decadence for any functional groups in the reference community.

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2,000 pounds per acre for below average moisture years and 4,000 pounds per acre for above average moisture years.

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:** Potential invasive species for this site includes yellow bluestems, bermudagrass, mesquite, elm, huisache, Eastern red cedar, osage orange and prickly pear.

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