USDA Natural Resources Conservation Service

Ecological site HX076XY103
Sodic Claypan

Last updated: 8/12/2019
Accessed: 05/11/2025

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

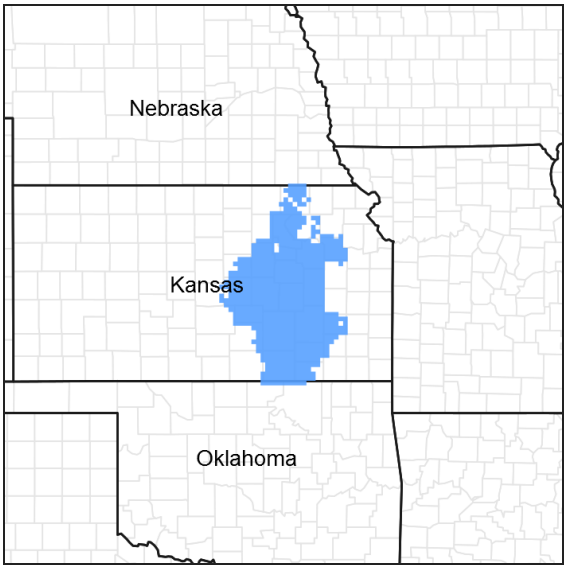


Figure 1. Mapped extent

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): 076X–Bluestem Hills

MLRA 76, is located in Kansas (84 percent) and Oklahoma (16 percent). It makes up about 7,555 square miles (19,585 square kilometers). The towns of Manhattan and El Dorado, Kansas, and Pawhuska, Oklahoma, are in this MLRA. The part of this area in Oklahoma lies between the towns of Ponca City and Bartlesville. Interstates 35 and 70 cross the part of the area in Kansas. The western edge of the Potawatomi Indian Reservation and the Fort Riley Military Base are in the part of the area in Kansas. Most of the Osage Indian Reservation in Oklahoma is in this area. The area is known as the “Flint Hills” in Kansas and the “Osage Hills” in Oklahoma.

Following are the various kinds of land use in this MLRA: Cropland— private, 18 percent; Grassland—private, 69 percent; Federal, 3 percent; Forest—private, 4 percent; Urban development—private, 3 percent; Water —private, 2 percent; Other —private, 1 percent.

Nearly all of this area is in farms or ranches. Nearly three fourths of the area supports native grasses grazed by beef cattle. Nearly one-fifth of the area, consisting mainly of the deeper soils in valleys and on some of the uplands, is cropland. Some winter wheat is grown as a cash crop. Other small grains, grain sorghum, alfalfa, and other kinds of hay are the major crops. These crops are also grown in small irrigated areas along the Arkansas River.

The major soil resource concerns are water erosion, surface compaction, moisture conservation, and maintenance of the content of organic matter in the soils. Maintenance of plant health and vigor and control of noxious and invading plants are the major management concerns on grassland. Conservation practices on cropland generally include terraces, grassed waterways, grade-control structures, conservation tillage, and nutrient and pest management. Conservation practices on rangeland generally include brush management, control of noxious weeds, nutrient management, and prescribed grazing.

Classification relationships

Land Resource Region H. Central Great Plains winter wheat and range region. Major Land Resource Area (MLRA) 76 Bluestem Hills.

Ecological site concept

This ecological site is located on nearly level uplands with a slope of 3 percent or less. Most Sodic Claypan sites are characterized by having slight depression areas often referred to as buffalo wallows occurring in the sites. The vegetation is influenced by the amount of sodium in the profile and the shallow depth to high percent clay in the subsoil. Clay content is greater than 35 percent at a depth between 2 to 8 inches. This site is characterized by relatively higher amount of sodium when compared to geographically associated sites. The amount of salts ranges from a SAR of 4 to 25, ESP of 5 to 36, and EC from .5 to 5.

Associated sites

HX076XY115	**Loamy Hills** The Loamy Hills ecological site sits adjacent to and in conjunction with the Sodic Claypan site. This site occurs on summit, shoulder positions, and footslopes (Tully soil). The Loamy Hills soils are well drained that formed from colluvium and in residuum from interbedded limestone and clayey shale. The Loamy Hills site has moderately deep to very deep soils with a silt loam to silty clay surface (7 to 14 inches).
HX076XY107	**Clay Hills** The Clay Hills ecological site sits adjacent to and in conjunction with the Sodic Claypan site. This site occurs on summit and shoulder positions with a clay content >35 percent at depths >14 inches. The Clay Hills site has moderately deep to very deep soils with a clay loam to silty clay surface (7 to 14 inches) over clayey subsoil. Although this site can retain large amounts of water, it is tightly held and therefore is not available in adequate amounts for the vegetation during stress periods.
HX076XY128	**Shallow Hills** The Shallow Hills ecological site sits adjacent to and in conjunction with the Sodic Claypan site. This site is characterized by the shallow depth to limestone or shale. This site generally occurs in narrow bands or shoulders on hillslopes. Limestone at the surface is almost always present on this site. The soil series Sogn and Kipson characterize this site. It consists of shallow and very shallow, somewhat excessively drained, soils that formed in residuum weathered from limestone or shale. Slopes range from 0 to 20 percent.

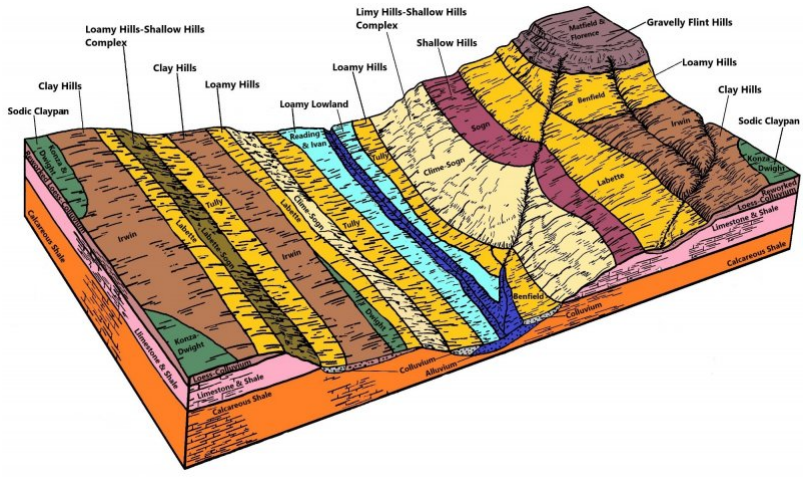


Figure 2. MLRA 76 ESD block diagram.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Schizachyrium scoparium*

Legacy ID

R076XY103KS

Physiographic features

Most of MLRA 76 is in the Osage Plains Section of the Central Lowland Province of the Interior Plains. The northern end of the area is in the Dissected Till Plains Section of the same province and division. The landscape consists of rolling hills and cuestas formed in dissected uplands that typically have narrow divides and narrow, steep-sided valleys where Pennsylvanian limestone bedrock is dominant. Stream valleys are less boxlike (broader) where the dominant bedrock is shale. Significant flood plains occur only along a few large streams. Elevation ranges from 980 to 1,650 feet (300 to 505 meters). Local relief is generally 10 to 25 feet (3 to 8 meters), but it can be 100 to 165 feet (30 to 50 meters).

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Neosho-Verdigris (1107),33 percent; Kansas (1027), 29 percent; Middle Arkansas (1103), 18 percent; Arkansas- Keystone (1106), 18 percent; and Republican (1025), 2 percent. The area has two large rivers. The Kansas River crosses the northern part of the area, and the Arkansas River runs along the southwestern edge. The smaller rivers that cross the area include the Vermillion, Mill, Neosho, Cottonwood, Fall, Verdigris, Grouse, Elk, Caney, and Bird Rivers.

The Sodic Claypan ecological site is situated on slightly concave depressional areas and nearly level to gently sloping interfluves and hillslopes (summits and backslopes) on uplands. Slopes are very rarely in excess of 3 percent. This site is often characterized by the presence of scattered depressions commonly referred to as “buffalo wallows.” This site is typically in a landform position that generates runoff.

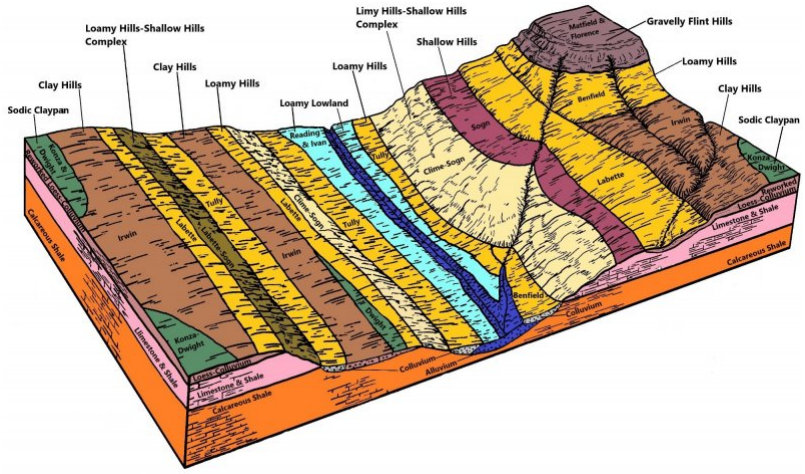


Figure 3. MLRA 76 ESD block diagram.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Backslope
Landforms	(1) Upland > Interfluve (2) Upland > Hillslope
Runoff class	Negligible to very low
Flooding frequency	None

Ponding frequency	None
Elevation	990–1,650 ft
Slope	0–3%
Aspect	Aspect is not a significant factor

Climatic features

The climate of this area is typically continental, being in the interior of a large landmass at mid latitudes. Large daily and annual variations in temperature are common. Winters are cold because of frequent polar air masses moving into the area from the north from December into March. Summer temperatures are warm and usually prevail for about six months of the year. June typically has the most rainfall, and January is the driest. Most of the rainfall occurs as high-intensity, convective thunderstorms. The annual snowfall averages 14 to 20 inches (355 to 510 millimeters). Drought occurs on an average of 3 times in a 30-year period (1981-2010) in MLRA 76.

The climate data listed in the following tables represent minimum and maximum averages and ranges for the climate stations located throughout MLRA 76. The dates referenced are from 1981-2010 (latest 30 year average). Average annual precipitation for this MLRA ranges from 32 to 40 inches (810 to 1020 millimeters). All weather data is supported by the National Oceanic and Atmospheric Administration (NOAA) 1981-2010 Climate Normals. For the average annual precipitation of individual climate station locations and additional climate data, access the National Water and Climate Center at http://www.wcc.nrcs.usda.gov

Table 3. Representative climatic features

Frost-free period (characteristic range)	144-162 days
Freeze-free period (characteristic range)	177-192 days
Precipitation total (characteristic range)	34-39 in
Frost-free period (actual range)	140-171 days
Freeze-free period (actual range)	167-194 days
Precipitation total (actual range)	33-40 in
Frost-free period (average)	154 days
Freeze-free period (average)	185 days
Precipitation total (average)	36 in

Climate stations used

- (1) TUTTLE CREEK LAKE [USC00148259], Manhattan, KS
- (2) MANHATTAN [USC00144972], Manhattan, KS
- (3) WAMEGO 4 W [USC00148563], Wamego, KS
- (4) MANHATTAN MUNI AP [USW00003936], Manhattan, KS
- (5) MANHATTAN 6 SSW [USW00053974], Manhattan, KS
- (6) COUNCIL GROVE LAKE [USC00141867], Council Grove, KS
- (7) TALLGRASS PRAIRIE NP [USC00148061], Strong City, KS
- (8) COTTONWOOD FALLS [USC00141858], Cottonwood Falls, KS
- (9) FLORENCE [USC00142773], Florence, KS
- (10) CASSODAY 2SW [USC00141351], Cassoday, KS
- (11) EL DORADO [USC00142401], El Dorado, KS
- (12) EUREKA 1E [USC00142622], Eureka, KS
- (13) SMILEYBERG 1N [USC00147534], Douglass, KS
- (14) WINFIELD 3NE [USC00148964], Winfield, KS
- (15) HOWARD 1W [USC00143822], Howard, KS

Influencing water features

The Sodic Claypan ecological site is situated on slightly concave depressional areas and nearly level to gently sloping interfluves and hillslopes (summits and backslopes) on uplands. Soils on this ecological site have very slow permeability. Although water holding capacity is high, all water is not available to plants because of the clay subsoil and high salt content in the soil, this results in the site being droughty. This site is often characterized by the presence of scattered depressions commonly referred to as “buffalo wallows.”

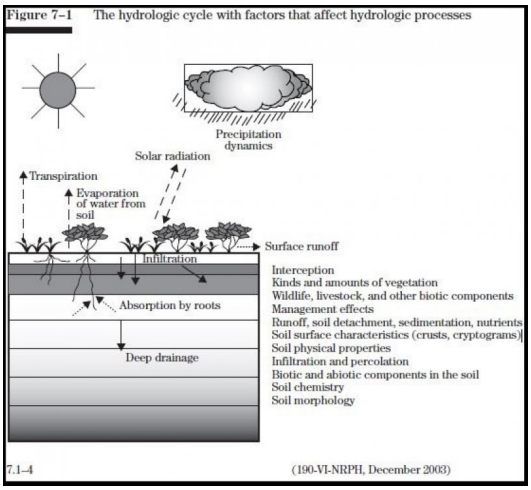


Figure 10. Fig. 7-1 from the National Range and Pasture Handbook.

Soil features

The Sodic Claypan ecological site was formerly named Claypan prior to 2006. Originally Dwight was the only soil series associated with the Claypan range site. Research on Dwight soils has shown that most of the acres mapped Dwight do not contain the high sodium levels required of the series to have a natric horizon. As a result, the soil series Konza was established in 1991 which still had higher levels of sodium then other geographically associated soils, but not as high sodium levels as Dwight. The sodium levels in Konza soils are high enough to influence soil properties and plant species. Konza is associated with the ESD Sodic Claypan formerly called Claypan. So far Konza soils have only been used in the update of the Geary County soil survey. In the future, many of the acres mapped Dwight will most likely be remapped to Konza.

The major soils that characterize the Sodic Claypan ecological site are Dwight and Konza. They consist of deep, nearly level or gently sloping uplands. Soil properties include a silty surface soil 2 to 8 inches in depth that lies over a dense, clayey subsoil which restricts the vertical development of plant root growth. This subsoil ranges from 35 to 60 percent clay and contains from 5 to 25 exchangeable sodium percent (ESP). The amount of clay combined with exchangeable sodium limits plants’ ability to extract water from these soils.

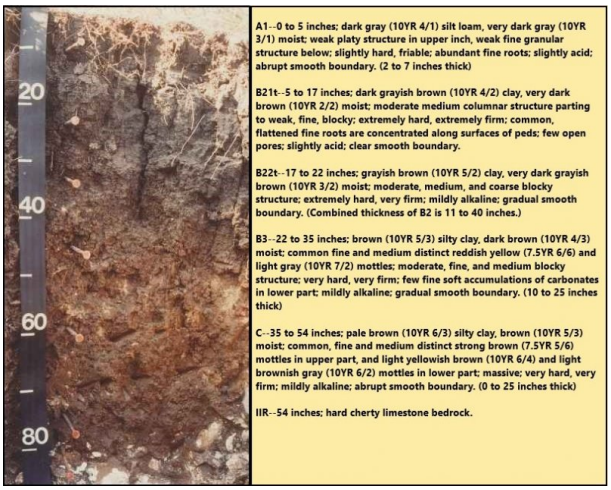


Figure 11. MLRA 76 Dwight soil series profile and description.

Table 4. Representative soil features

Parent material	(1) Loess (2) Colluvium (3) Residuum
Surface texture	(1) Silt loam (2) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Moderately well drained
Permeability class	Very slow
Depth to restrictive layer	40 in
Soil depth	40–80 in
Available water capacity (0-40in)	3–6.9 in
Calcium carbonate equivalent (0-40in)	0–2%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	4–25
Soil reaction (1:1 water) (0-40in)	5.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–5%

Ecological dynamics

The information in this ecological site description (ESD), including the state and transition model (STM), was developed using archeological and historical data, professional experience, and scientific studies. The information is representative of a complex set of plant communities. Not all scenarios or plants are included. Key indicator plants, animals, and ecological processes are described to inform land management decisions.

The Sodic Claypan ecological site is located on nearly level uplands with a slope of 3 percent or less. Most sites are characterized by having slight depression areas often referred to as buffalo wallows occurring in the sites. The vegetation is influenced by the amount of sodium in the profile and the shallow depth to high percent clay in the subsoil. Clay content 35-60 percent at a depth between 2 to 8 inches. This site is characterized by relatively higher amount of sodium when compared to geographically associated sites. The amount of salts ranges from a SAR of 4 to 25, ESP of 5 to 36, and EC from .5 to 5.

The Sodic Claypan ecological site in MLRA 76 consist of dynamic plant communities resulting from the complex interaction of many ecological factors and processes.The site was exposed to a diverse and fluctuating climate, grazed by herds of large herbivores, and periodically subjected to intense wildfires. The plants that evolved and dominated the original plant community were well adapted to these climatic, soil, and biological conditions. The tallgrasses that evolved and dominated the original plant community have root systems capable of utilizing moisture throughout most of the soil profile. Concentration of grass roots in the surface soil permits good oxygen and carbon dioxide exchange and efficient water uptake after precipitation events. Deeper roots that penetrate the clayey subsoil generally provide sufficient moisture to sustain limited plant growth during most dry periods.

The soils on this site include physical characteristics that considerably influence plant growth. First, plants have evolved in soils with dense clay subsoils that restrict vertical root development. Second, although subsoil water holding capacity is high, its slow release of water to plants causes the site to be droughty. Third, plants' ability to extract water from the subsoil is limited by the amount of exchangeable sodium present.

The site developed with fire playing an important role in ecological processes. Historically fires were usually started

by lightning, typically during spring and early summer months when thunderstorms were most prevalent. It is also recognized that early Native Americans often used fire to attract herds of migratory herbivores, especially bison. These intentional fires probably occurred more frequently, even on an annual basis. Because all of the dominant grasses were rhizomatous, they were able to survive the ravages of even intense wildfires and gain a competitive advantage in the plant community. By contrast, most trees and shrubs were suppressed by fire and occurred only sparsely on protected areas on associated Loamy Hills ecological site. Growth of forbs, especially legumes, was usually enhanced following a fire event. After a fire there was usually a substantial increase in the abundance of annual forbs as well. Although temporary, this increase may have lasted for one to two years.

Herd behavior and grazing patterns had a major impact on the dynamics of this site. As the site was a natural loafing area for bison, this particular vegetative community developed under heavy use. The uniqueness of the site is that bison used its depressions or wallows for dusting and/or mudding to protect themselves from pesky, biting insects, particularly as they shed their winter coats. It is not hard to imagine that elk had similar habits to the buffalo in this regard as they are known to “wallow” in melting snow or mud, too. Additionally, because the site is situated on ridge tops, the prevailing southern winds provided some degree of comfort from heat and humidity and also helped keep the persistent swarms of gnats and flies away. Typically, herds did move on to adjacent areas and the vegetation was afforded a period of recovery. Other grazing and feeding animals such as deer, rabbits, insects, and numerous burrowing rodents had secondary influences on plant community development.

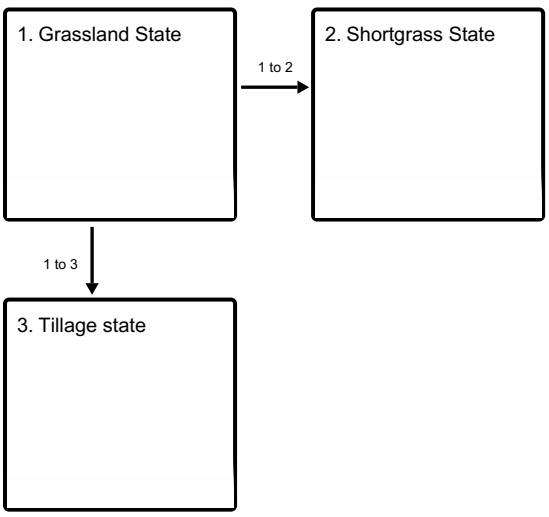
Variations in climate, especially drought cycles, also had a major impact upon the plant community’s development. Species composition fluctuated according to the duration and severity of droughts. During prolonged dry cycles, many of the shallow rooted plants died out and the production of deeper rooted plants significantly decreased. When sufficient rainfall occurred following an extended period of dry years, annual forbs and annual grasses would temporarily occur in great abundance. As precipitation returned to normal or above normal, the deeper rooted grasses responded quickly to production potentials.

As the practice of fencing and domestic livestock husbandry replaced open spaces and wild herds of wandering bison, elk, pronghorn, and deer the site’s ecological dynamics were altered and the plant community changed from its original composition. Changes were usually in proportion to the season and intensity of grazing livestock and were accelerated by a combination of drought and overgrazing. For example, the taller grasses and forbs palatable to bison and elk were equally relished and selected by cattle. When repeatedly grazed, these plants were weakened and gradually replaced by the increase and spread of less palatable midgrasses and forbs. Where the history of overgrazing by domestic livestock was intense for many years, even the plants that initially increased were often replaced by even less desirable, lower producing vegetation. In some areas plant cover was reduced to a mixture of native shortgrasses, annual grasses, and forbs.

The following diagram illustrates some of the pathways that the vegetation on this site may take from the Reference Plant Community as influencing ecological factors change. There may be other states or plant communities not shown on the diagram, as well as noticeable variations within those illustrated.

State and transition model

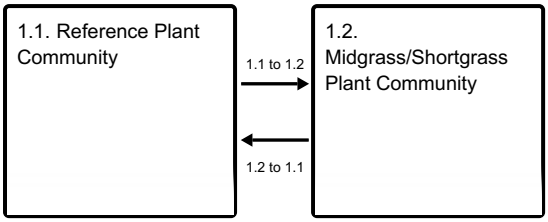
Ecosystem states



1 to 2 - Long-term, heavy, continuous overgrazing, no rest and recovery

1 to 3 - Lack of fire and brush control

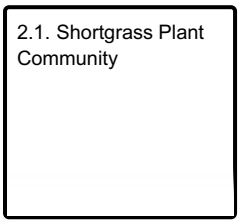
State 1 submodel, plant communities



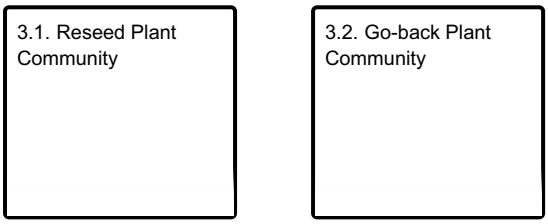
1.1 to 1.2 - Heavy, continuous grazing without adequate rest and recovery

1.2 to 1.1 - Prescribed grazing that incorporates periods of deferment during the growing season

State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Grassland State

The Grassland State defines the ecological potential and natural range of variability resulting from the natural disturbance regime of the Sodic Claypan ecological site. This state is supported by empirical data, historical data, local expertise, and photographs. It is defined by a suite of native plant communities that are a result of periodic fire, drought, and grazing by bison. These events are part of the natural disturbance regime and climatic process. The soil dynamic properties that can influence community phase and state changes are organic matter content, biological activity, aggregate stability, infiltration, soil fertility, and soil reaction. Other grazing and feeding animals such as elk, pronghorns, deer, rabbits, insects, and numerous burrowing rodents had secondary influences on plant community development. Today, cattle are the primary grazers on this ecological site. Within the grassland state, the woody vegetation will generally be less than 15 percent canopy cover per acre. If introduced, invasive or noxious plants are present, they should not exceed 15 percent of the total pounds of vegetation produced per acre in order to avoid crossing a threshold. Plant communities within this state function similarly in their capacity to limit soil loss, cycle water, and produce vegetative biomass. The plant community phases can vary through changes in grazing management or fluctuating climatic conditions. The variables that control the resilience of this grassland state are long-term grazing management and frequency of fire.

Characteristics and indicators. Tallgrasses and Migrasses are dominant in the Grassland State.

Resilience management. Management strategies that will sustain this state include monitoring key forage species and providing a forage and animal balance.

Community 1.1
Reference Plant Community

Figure 12. MLRA 76 Reference Plant Community.

Figure 13. MLRA 76 Reference Plant Community.

Figure 14. MLRA 76 Reference Plant Community.

This description of the reference community for the site is based on early range site descriptions, clipping data, professional consensus of experienced range specialists, and analysis of field work. The interpretive plant community for the Sodic Claypan ecological site is the Reference Plant Community, and represents the original plant community that existed prior to European settlement. Characterized as open grassland essentially free of trees and large shrubs. It is dominated by tall- and mid-, warm-season grasses including big bluestem, little bluestem, switchgrass, sideoats grama, western wheatgrass, and composite dropseed. There is a predominance of buffalograss and blue grama in the wallows or depressions because of its high tolerance of salinity and anaerobic conditions which exist during long periods of inundation. Limited amounts of switchgrass may persist, but usually most prevalent in community phase 1.2. The site supports a wide variety of native forbs and legumes interspersed throughout its grassy plain. The most abundant are dotted blazing star, cuman ragweed, upright prairie coneflower, slimflower scurfpea, white heath aster, white sagebrush, field pussytoes, common yarrow, and Missouri goldenrod.

Resilience management. This is a stable plant community when grazing and fire are adequately managed. A prescribed grazing program that incorporates periods of grazing rest and recovery of key forage species during the growing season benefits the tallgrasses as well as the more palatable forb species. Excessive grazing and livestock trailing can quickly impact soil stability and lead to sheet and gully erosion. Because this site often occurs on summits, shoulders, and other high elevations on the landscape, it is preferred by grazing animals during the hot days of late summer. Cattle and other livestock commonly graze into the prevailing southerly winds and find loafing areas in this site to gain relief from heat and insects. Concentrated livestock use, such as winter feeding areas, can cause compaction of the wet, clay soils and stress the dominant tallgrasses.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- switchgrass (*Panicum virgatum*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- composite dropseed (*Sporobolus compositus var. compositus*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1760	2640	3520
Forb	200	300	400
Shrub/Vine	40	60	80
Total	**2000**	**3000**	**4000**

Figure 16. Plant community growth curve (percent production by month). KS7605, Sodic Claypan. Active growth of warm-season grasses on this site typically begins during the period of May 1 to May 15 and continues until mid-September. As a general rule, 75 percent of total production is completed by mid-July. This varies only slightly from year to year depending on temperature and precipitation patterns. There are exceptions as big bluestem will occasionally initiate spring growth in early April following mild winter temperatures. Also, it is not unusual for other warm-season grasses such as Indiangrass and little bluestem to have some new leaf growth arising from basal buds in late October following moderate fall temperatures. Cool-season grasses, sedges, and rushes generally have two primary growth periods, one in the spring (March through early June) and again in the fall (September and October). Some growth may occur in winter months during periods of unseasonably mild temperatures..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	3	10	17	20	20	10	10	8	1	

Community 1.2
Midgrass/Shortgrass Plant Community

Figure 17. MLRA 76 Midgrass/Shortgrass Plant Community.

Figure 18. MLRA 76 Midgrass/Shortgrass Plant Community.

Figure 19. MLRA 76 Midrass/Shortgrass Plant Community.

Figure 20. MLRA 76 Midrass/Shortgrass Plant Community.

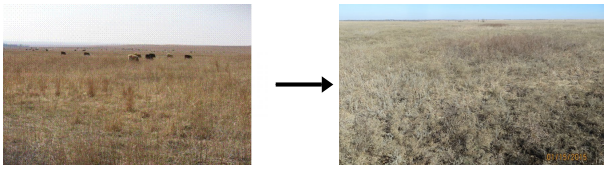
Developed after many years of repeated, heavy, continuous overgrazing this plant community presents a distinctively shorter aspect of predominant grasses on the landscape. Blue grama, buffalograss, and western wheatgrass comprise the majority of the site. Midgrasses include little bluestem, sideoats grama, composite dropseed, and purple lovegrass. Tallgrasses have been all but eliminated with surviving plants being in a very low state of vigor. Shortgrasses such as Kentucky bluegrass, tumble windmill grass, tumblegrass, fall panicgrass, and little barley play a more prominent role. Forb production is quite variable and may range from 10 to 25 percent of the total vegetation depending on amounts and timing of rainfall events. Perennial forbs include white sagebrush, slimflower scurfpea, Missouri goldenrod, white heath aster, and Cuman ragweed.

Resilience management. Recovery of the tallgrasses, midgrasses, and associated forbs characteristic of the Reference Plant Community will require many years of careful management that includes prescribed grazing and extended periods of rest and recovery during the growing season. If remnant stands of the desired species are not present or located nearby as seed sources for reestablishment, interseeding measures may be needed to create pioneer colonies for seed dispersal throughout the community. Prescribed burning can be a useful tool if used strategically to benefit the desired species, especially in the later stages of the recovery process that may take more than a decade.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- composite dropseed (*Sporobolus compositus var. compositus*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass

Pathway 1.1 to 1.2
Community 1.1 to 1.2



Reference Plant Community

Midgrass/Shortgrass Plant Community

These mechanisms include management controlled by repetitive heavy use, no rest or recovery of the key forage species and no forage and animal balance for many extended grazing seasons. This type of management lasting for periods greater than 10 years will shift functional and structural plant group dominance towards a midgrass plant community. Annual burning or a fire frequency occurrence <2 years will cause a shift in community phases. The frequency of late spring annual burning in combination with late season rest may result in a shift in species diversity as well as fluctuations in productivity. Herbicide use every 1-3 years will remove legumes and forbs and become a grass dominated community. Drought conditions that persist >3 years with below average rainfall during the first half

of the growing season in addition to inadequate rest provided for plant recovery will result in productivity changes. This is a stable plant community when plants are provided adequate rest and recovery. A prescribed grazing program that incorporates periods of rest and recovery during the growing season benefits both tallgrasses and the more-palatable forb species. Excessive grazing and livestock trailing can impact soil site stability, biotic integrity, and hydrologic function which can result in a shift to another plant community.

Context dependence. Plant community composition shifts from Tallgrass to Midgrass dominant.

Pathway 1.2 to 1.1
Community 1.2 to 1.1

Midgrass/Shortgrass Plant Community **Reference Plant Community**

Recovery of the tallgrasses, midgrasses, and associated forbs characteristic of the Reference Plant Community will require approximately 10-15 years of careful management that includes extended periods of rest and recovery during the growing season as well as monitoring maximum grazing heights of vegetation. If remnant stands of the desired species are not located nearby as seed sources for reestablishment, inter-seeding measures may be necessary to create pioneer colonies for seed dispersal throughout the community. Prescribed fire every 2 or 3 years can be a useful tool if used strategically to benefit the desired species. It is especially useful in the later stages of the recovery process, which may take more than a decade.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Shortgrass State

With heavy, continuous grazing, blue grama, and buffalograss will become the dominant species and have a sod-bound appearance. Unable to withstand the grazing pressure, only a remnant population of western wheatgrass remains.

Characteristics and indicators. The Shortgrass State is characterized with specific dynamic soil property changes. Changes between the Grassland State and the Shortgrass State has been documented. As plant community cover decreases from bunchgrasses to more of the sod grasses there is a decrease in infiltration and interception and an increase in surface runoff (Thurow T., 2003).

Resilience management. This is a resistant and resilient state. Grazing management practice should include a forage and animal balance.

Community 2.1
Shortgrass Plant Community

This plant community presents a distinctive shortgrass aspect on the landscape. It is dominated by blue grama and buffalograss with notable amounts of western wheatgrass and sideoats grama present. Other grasses include annual bromes, composite dropseed, Kentucky bluegrass, prairie threeawn, and tumble windmill grass. These species commonly account for 60 to 70 percent of the annual forage production. Like the desirable grasses, palatable legumes and other forbs have been reduced by continuous grazing and competition over many years. Prevalent broadleaf species in this situation include prairie broomweed, annual ragweed, white sagebrush, Cuman ragweed, interior ironweed, wavyleaf thistle, and curlycup gumweed. Forbs may comprise 15 to 25 percent of the total vegetation. This plant community often contains 15 to 20 percent woody species as a result of fewer fires and more opportunities for their encroachment. Eastern redcedar, smooth and/or fragrant sumac, roughleaf dogwood,

and coralberry are representative trees and shrubs which occur on this site. Leadplant and Jersey tea may still be found, but are generally much reduced from their prominence in the Reference Plant Community.

Resilience management. This plant community can be managed as a stable shortgrass plant community. If recovery of the tallgrasses, midgrasses, and associated forbs characteristic of the Reference Plant Community is desired, however, many years of careful management that includes prescribed grazing and extended periods of rest during the growing season will be required. More study is necessary in order to document restoration processes to the Grassland State. This site may recover faster than adjoining ones as remnant plants may be somewhat protected by the steeper slopes and occasional surface rocks. Where remnant stands of the desired species are not available on or near the site, reseeding may be necessary to advance recovery. However, seeding or interseeding may be severely limited by the steepness of slope and occasional surface rocks.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

State 3
Tillage state

Areas of the historic Sodic Claypan plant communities were plowed and converted to production of cultivated crops by the early European settlers and subsequent generations. In addition to destroying the original plant community, repeated tillage commonly resulted in major changes in soil conditions. Reductions in organic matter, mineral levels, soil structure, oxygen levels, and water holding capacity, along with increased runoff/erosion and shifts in the populations of soil-dwelling organisms, were common on these sites. The extent of these changes depended upon duration of cropping as well as crops grown and other management practices. The Tillage State consists of abandoned cropland that has been naturally revegetated (go-back) or planted/seeded to grassland. Many reseeded plant communities were planted with a local seeding mix under the Conservation Reserve Program (CRP) or were planted to a monoculture of sideoats grama. Go-back communities are difficult to define due to the variability of plant communities that can exist. Many of these communities are represented by the genus Aristida (threeawns).

Characteristics and indicators. This is an alternative state since the energy, hydrologic, and nutrient cycles are altered to that of the Reference State in its natural disturbance regime. Bulk density, aggregate stability, soil structure, and plant functional and structural groups are not fully restored to that of the Reference State. Mechanical tillage can destroy soil aggregation. Soil aggregates are an example of dynamic soil property change. Aggregate stability is critical for infiltration, root growth, and resistance to water and wind erosion (Brady and Weil, 2008).

Resilience management. This state is a result of a land use management decision.

Community 3.1
Reseed Plant Community

Figure 21. MLRA 76 Reseed Plant Community.

Figure 22. MLRA 76 Reseed Brome grass.

This plant community occurs on areas that were formerly farmed and reseeded with a mixture of native species common in the Reference Plant Community. Most seeding mixtures consisted of a blend of grasses that include sand bluestem, Indiangrass, switchgrass, little bluestem, sideoats grama, blue grama, and western wheatgrass. In some locations, seed of legumes and forbs such as prairie bundleflower and Maximilian sunflower were included in the mixture. Once these areas become fully established, production is comparable to that of the Reference Plant Community. Total annual production ranges varies according to the species planted, established plants, and years of establishment. When reseeded areas and areas supporting native rangeland exist in the same pasture, they seldom are utilized at the same intensity because domestic livestock usually prefer plants growing on the native rangeland areas. When feasible, reseeded plant communities should be managed as separate pastures or units. Some seeded areas are invaded by trees and shrubs during the establishment period of the desired plants. These invader species commonly include elm, common hackberry, eastern redcedar, and eastern cottonwood. Occasional burning is effective in controlling establishment of these woody plants.

Resilience management. Following termination of cultivation, total annual production is quite variable and full recovery of the original plant community, including forbs and legumes, may take many decades. Additions of organic matter and minerals, deferred grazing, prescribed burning, and related management practices described earlier for this ecological site can be beneficial to the rehabilitation.

Community 3.2
Go-back Plant Community

Figure 23. MLRA 76 Go-back Plant Community.

Figure 24. MLRA 76 Go-back Plant Community.

This plant community also occurs on areas that were formerly farmed. When tillage operations ceased, the areas were allowed to revegetate or “go back” naturally in contrast to artificial reseeding to a selected species or group of species. The go-back process is a slow, gradual transformation that requires many years and many successional changes or stages in the plant community. The speed and extent of revegetation depends on the size of the area, level of grazing management and the proximity of the area to existing seed sources. In the initial stages of revegetation the site is usually dominated by annual forbs such as annual ragweed, slender snakecotton, Canadian horseweed, prairie sunflower, common sunflower, Mexican fireweed, camphorweed, and annual buckwheat. Gradually these are replaced by annual grasses including prairie threeawn, mat sandbur, tumblegrass, little barley, cheatgrass, and witchgrass. As plant succession progresses the plant community gradually becomes dominated by perennials. The major grasses include sand dropseed, composite dropseed, thin paspalum, purple lovegrass, red lovegrass, Scribner’s rosette grass, Carolina crabgrass, silver beardgrass, and tumble windmillgrass. Common forbs are Cuman ragweed, white sagebrush, Carruth’s sagewort, white heath aster, Missouri goldenrod, and sand milkweed. Combinations of these plants can form a stable community. In time with prescribed grazing management, other perennial grasses and forbs common in the Reference Plant Community return to the site. Blue grama is a shortgrass that is very common to the native plant communities on this site. However, it seldom occurs in go-back communities, even after 40 to 50 years of plant succession. Some go-back areas are invaded by trees and shrubs. The more common include elm, common hackberry, eastern redcedar, eastern cottonwood, and roughleaf dogwood. Occasional burning is effective in controlling these woody plants. Total annual production varies by site. This depends on seasonal precipitation and the stage of plant succession in the plant community.

Resilience management. Following termination of cultivation, total annual production is quite variable and full recovery of the original plant community, including forbs and legumes, may take many decades. Additions of organic matter and minerals, deferred grazing, prescribed burning, and related management practices described earlier for this ecological site can be beneficial to the rehabilitation.

Transition 1 to 2
State 1 to 2

Long-term management (approximately 30 years) without a forage and animal balance and heavy, continuous grazing without adequate recovery periods between grazing events will convert the Grassland State to a Shortgrass State made up of blue grama and buffalograss sod. Drought in combination with this type of management will quicken the rate at which this transition occurs.

Constraints to recovery. The ecological processes affected are the hydrologic and nutrient cycles. There is an increase in evaporation rate, runoff, and in bulk density. There is a decrease in infiltration, a change in plant composition, and the functional and structural groups have changed dominance. These are all examples of the soil and vegetation properties that have compromised the resilience of the Grassland State and therefore transitioned to a Shortgrass State.

Transition 1 to 3
State 1 to 3

This transition is triggered by a management action as opposed to a natural event. Tillage, or breaking the ground with machinery for crop production, will move the Grassland State to a Tillage State.

Constraints to recovery. The resilience of the Reference State has been compromised by the fracturing and blending of the native virgin sod. The energy, hydrologic, and nutrient cycles are altered and vary from that of the Grassland State.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tallgrasses**			600–1200	
	big bluestem	ANGE	*Andropogon gerardii*	300–600	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	150–300	–
	switchgrass	PAVI2	*Panicum virgatum*	75–250	–
	Indiangrass	SONU2	*Sorghastrum nutans*	50–200	–
2	**Midgrasses**			350–690	
	little bluestem	SCSC	*Schizachyrium scoparium*	300–500	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	100–300	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	30–40	–
3	**Shortgrasses**			100–300	
	buffalograss	BODA2	*Bouteloua dactyloides*	50–200	–
	blue grama	BOGR2	*Bouteloua gracilis*	50–100	–
4	**Cool-season grasses**			300–450	
	western wheatgrass	PASM	*Pascopyrum smithii*	250–450	–
	sedge	CAREX	*Carex*	10–50	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	10–50	–
	Canada wildrye	ELCA4	*Elymus canadensis*	10–50	–
	rush	JUNCU	*Juncus*	10–50	–
Forb					
5	**Forbs**			150–300	
	dotted blazing star	LIPU	*Liatris punctata*	20–60	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	20–60	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	10–40	–
	blue wild indigo	BAAUM	*Baptisia australis var. minor*	10–40	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	20–40	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	10–40	–
	white heath aster	SYER	*Symphyotrichum ericoides*	20–40	–
	common yarrow	ACMI2	*Achillea millefolium*	10–30	–
	purple prairie clover	DAPUP	*Dalea purpurea var. purpurea*	10–30	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	10–30	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	10–30	–
	blacksamson	ECANA	*Echinacea angustifolia var. angustifolia*	0–30	–

	echinacea				
	stiff goldenrod	OLRIR	*Oligoneuron rigidum var. rigidum*	0–30	–
	aromatic aster	SYOB	*Symphyotrichum oblongifolium*	0–20	–
	prairie broomweed	AMDR	*Amphiachyris dracunculoides*	0–20	–
	field pussytoes	ANNE	*Antennaria neglecta*	10–20	–
	grooved flax	LISU4	*Linum sulcatum*	0–15	–
	woodsorrel	OXALI	*Oxalis*	0–10	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–10	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–10	–
	Texas croton	CRTE4	*Croton texensis*	0–10	–
	fringeleaf wild petunia	RUHU	*Ruellia humilis*	0–10	–
	wholeleaf rosinweed	SIIN2	*Silphium integrifolium*	0–10	–
Shrub/Vine					
6	**Shrubs**			0–60	
	rose	ROSA5	*Rosa*	0–60	–
	leadplant	AMCA6	*Amorpha canescens*	0–60	–

Animal community

Wildlife

The Sodic Claypan ecological site is a unique prairie wildlife habitat when maintained in good to excellent condition. It is home to the tiger salamander and the Great Plains toad. Both inhabit animal burrows and remain hidden during the day, emerging at night to forage for insects and, in the case of the salamander, even eat small rodents. They breed during the spring and summer months when adequate rainfall fills temporary depressions or buffalo wallows. Other amphibians and reptiles can be found on the site as well.

During wet cycles, the shallow depressions associated with the site provide a watery habitat for the ephemeral fairy shrimp and its cousin the tadpole shrimp. These two species of aquatic invertebrates are very unique in the fact that their desiccated eggs (cysts) can survive extended drought periods in buffalo wallows and other prairie depressions. When these fill with water, the shrimp can complete their life cycle in a matter of days.

The site also provides nesting habitat for a number of ground nesting bird species including eastern and western meadowlarks and the upland sandpiper. The greater prairie chicken often uses this site for booming grounds or “leks” where the males carry out their courtship displays, a truly unique prairie ritual.

Historically big game animals such as white-tailed deer, elk, pronghorn, and bison used this site for grazing.

The Sodic Claypan site, being an open prairie with shorter grasses, is a preferred habitat for the black-tailed jack rabbit. Other small mammals such as the thirteen-lined ground squirrel are found on the site as well. Larger predators such as the coyote and badger are attracted by these smaller animals as are avian predators such as hawks and owls.

Some animals are important because of their threatened and endangered status and require special consideration. Please check the Kansas Department of Wildlife and Parks and Tourism (KDWP&T) website at www.ksoutdoors.com for the most current listing for your county.

Grazing Interpretations

Calculating Safe Stocking Rates: Proper stocking rates should be incorporated into a grazing management strategy that protects the resource, maintains or improves rangeland health, and is consistent with management objectives. In addition to usable forage, safe stocking rates should consider ecological condition, trend of the site, past grazing use history, season of use, stock density, kind and class of livestock, forage digestibility, forage nutritional value,

variation of harvest efficiency based on preference of plant species, and/or grazing system, and site grazeability factors (such as steep slopes, site inaccessibility, or distance to drinking water).

Often the current plant community does not entirely match any particular Community Phase as described in this Ecological Site Description. Because of this, a resource inventory is necessary to document plant composition and production. Proper interpretation of inventory data will permit the establishment of a safe initial stocking rate.

No two years have exactly the same weather conditions. For this reason, year-to-year and season-to-season fluctuations in forage production are to be expected on grazing lands. Livestock producers must make timely adjustments in the numbers of animals or in the length of grazing periods to avoid overuse of forage plants when production is unfavorable, and to make advantageous adjustments when forage supplies are above average.

Initial stocking rates should be improved through the use of vegetation monitoring and actual use records that include number and type of livestock, the timing and duration of grazing, and utilization levels. Actual use records over time will assist in making stocking rate adjustments based on the variability factors. Average annual production must be measured or estimated to properly assess useable forage production and stocking rates.

Hydrological functions

Following are the estimated withdrawals of freshwater by use in MLRA 76: Public supply—surface water, 12.9%; ground water, 10.2% Livestock— surface water, 15.8%; ground water, 4.5% Irrigation—surface water, 53.9%; ground water, 2.7% Other—surface water, 0.0%; ground water, 0.0%

The total withdrawals average 35 million gallons per day (130 million liters per day). About 17 percent is from ground water sources, and 83 percent is from surface water sources. The moderate precipitation provides water for pastures and crops. Much of the water for livestock is stored in small reservoirs and ponds. A small area is irrigated with water from the Arkansas River in Oklahoma. The surface water is generally of good quality and is suitable for most uses.

Both Dwight and Konza soils are in hydrologic groups D. Because Sodic Claypan soils take in water very slowly, large amounts of rainfall are lost to runoff. Please refer to the NRCS National Engineering Handbook Section 4 (NEH-4) for runoff quantities and hydrologic curves when making hydrology determinations.

Recreational uses

This site provides opportunities for a variety of outdoor activities which might include bird watching, hiking, outdoor/wildlife photography, and hunting. A wide variety of plants is in bloom throughout the growing season, especially in those years with average and above rainfall, providing much aesthetic appeal to the landscape. This site is subject to sheet erosion when mismanaged.

Wood products

This site produces no wood products.

Other products

None

Other information

Site Development and Testing Plan

This site went through the approval process.

Because of its landscape setting, this site is attractive to many for home sites and other developments. However, the high clay content (high shrink-swell potential) of these soils can create foundation problems and severely limit their suitability for septic systems and access roads.

Inventory data references

Information presented here has been derived from NRCS clipping data, numerous ocular estimates and other inventory data. Field observations from experienced range-trained personnel was used extensively to develop this ecological site description.

NRCS contracted the development of MLRA 79 ESDs in 2005. Extensive review and improvements were made to those foundational ESDs in 2017-2018 which provided an approved product.

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Contributors

Chris Tecklenburg

Approval

David Kraft, 8/12/2019

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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)	Chris Tecklenburg/Revision 1-31-2019 David Kraft, John Henry, Doug Spencer and Dwayne Rice/original authors 1-15-2005.
Contact for lead author	State Rangeland Management Specialist for Kansas.
Date	01/31/2019
Approved by	

Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** No natural rill formation common or part of the Sodic Claypan ecological site.

2. **Presence of water flow patterns:** There are no water flow patterns evidenced by litter, soil, or gravel redistribution, or pedestalling of vegetation or stones that break the flow of water as a result of overland flow.

3. **Number and height of erosional pedestals or terracettes:** There is no evidence of pedestals or terracettes that would indicate the movement of soil by water and/or by wind on this site.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 5% bare ground is found on this site. It is the remaining ground cover after accounting for ground surface covered by vegetation (basal and canopy [foliar] cover), litter, standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

5. **Number of gullies and erosion associated with gullies:** No evidence of accelerated water flow resulting in downcutting of the soil.

6. **Extent of wind scoured, blowouts and/or depositional areas:** No wind-scoured or blowout areas where the finer particles of the topsoil have blown away, sometimes leaving residual gravel, rock, or exposed roots on the soil surface. Also, there are no areas of redeposited soil onto this site from another site due to the wind, i.e., depositional areas.

7. **Amount of litter movement (describe size and distance expected to travel):** No evidence of litter movement (i.e., dead plant material that is in contact with the soil surface).

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surfaces may be stabilized by soil organic matter which has been fully incorporated into aggregates at the soil surface, adhesion of decomposing organic matter to the soil surface, and biological crusts. A soil stability kit will score a range from 5-6.

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

   A--0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium granular structure; soft, very friable, sticky and plastic; many fine roots throughout; very few distinct dark gray (10YR 4/1) discontinuous skeletans (sand or silt) on faces of peds; slightly acid; clear smooth boundary. (Thickness ranges from 3 to 8 inches.)

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Functional and structural groups are that of the Reference Plant Community (see functional and structural group worksheet). Note changes to plant communities if different than that of the functional and structural group worksheet.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** There is no evidence of a compacted soil layer less than 6 inches from the soil surface. Soil structure is similar to that described in Indicator 9. Compacted physical features will include platy, blocky, dense soil structure over less dense soil layers, horizontal root growth, and increase bulk density (measured by weighing a known volume of oven-dry soil).

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: Group 1 Tallgrass dominant 40% 1200 lbs. big bluestem 300-600, switchgrass 75-250, Indiangrass 50-200, composite dropseed 150-300

    Sub-dominant: Group 2 Midgrass subdominant 23% 690 lbs. little bluestem 300-500, sideoats grama 100-300, purple lovegrass 30-40

    Group 4 Cool-season grass Subdominant 15% 450 lbs. Western wheatgrass 250-450 lbs. sedge 10-50, Canada wildrye 10-50, Scribner's rosette grass 10-50, rush 10-50.

    Other: Group 3 Shortgrass minor 10% 300 lbs. buffalograss 50-200, blue grama 50-100

    Additional: Group 5 forbs Minor 10% 300 lbs. see Reference Plant community for entire list
    Group 6 shrub Trace 2% 60 lbs. leadplant 0-60 lbs., prairie rose 0-60.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Recruitment of plants is occurring and there is a mixture of many age classes of plants. The majority of the plants are alive and vigorous. Some mortality and decadence is expected for the site, due to drought, unexpected wildfire, or a combination of the two events. This would be expected for both dominant and subdominant groups.

14. **Average percent litter cover (%) and depth (in):** Plant litter is distributed evenly throughout the site. There is no restriction to plant regeneration due to depth of litter. When prescribed burning is practiced, there will be little litter the first half of the growing season.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** All species (e.g., native, seeded, and weeds) alive in the year of the evaluation, are included in the determination of total above ground production. Site potential (total annual production) ranges from 2,000 lbs in a below-average rainfall year and 4,000 lbs in an above-average rainfall year. The representative value for this site is 3,000 lbs production per year.

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:** There are no noxious weeds present. Invasive plants make up a small percentage of plant community, and invasive brush species are < 5% canopy.

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17. **Perennial plant reproductive capability:** Plants on site exhibit the required vigor and growth to be able to reproduce vegetatively or by seed. Current management activities do not adversely effect the capability of plants to reproduce.
