USDA Natural Resources Conservation Service

Ecological site R073XY112KS Shallow Limy

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Accessed: 05/25/2025

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.

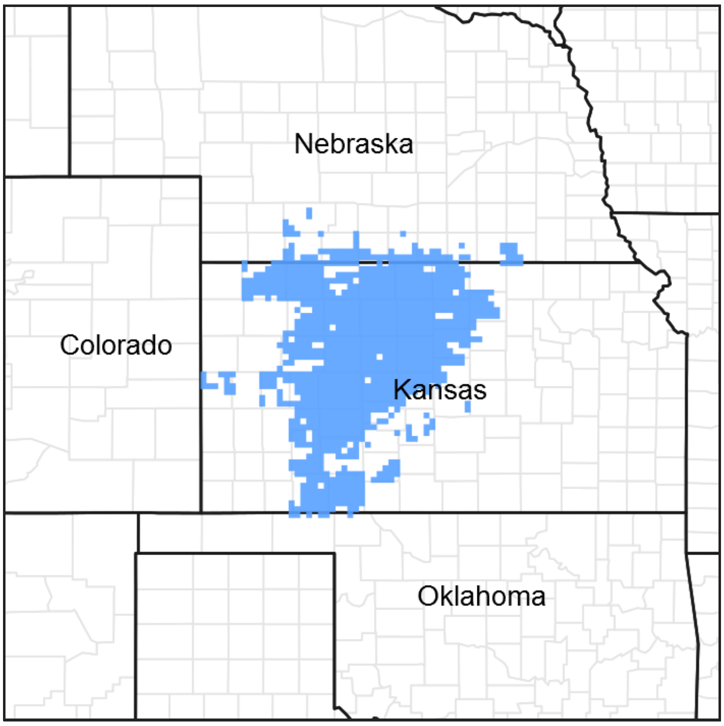


Figure 1. Mapped extent

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): 073X–Rolling Plains and Breaks

This ESD is located in the Rolling Plains and Breaks Major Land Resource Area (MLRA)

73 of the Central Great Plains Winter Wheat and Range Region of the United States. MLRA 73 is in Kansas (78 percent) and Nebraska (22 percent). It makes up about 21,485 square miles (13,750,400 acres). The towns of Hays, Great Bend, and Dodge City, Kansas, and Alma, Curtis, Holdrege, and McCook, Nebraska are in this MLRA. The MLRA is bisected by Interstate 70. The Platte River is at the northern edge of the area, and the Arkansas River is at the southern edge.

Classification relationships

Major land resource area (MLRA): 073-Rolling Plains and Breaks

Ecological site concept

The Shallow Limy (073XY112) ecological site was formerly known as Shallow Limy with identification number 073XY012. The Shallow Limy ecological site occurs on nearly level to rough broken and steeply sloping uplands. This site is generally on the breaks of the hills between the uplands and valleys. Much of the site is steep and associated with rock ledges forming vertical drops. The soils on this site range from 10 to 20 inches deep over caliche or fractured limestone.

Associated sites

R073XY100KS	**Loamy Plains** The Loamy Plains ecological site is commonly located adjacent to or in coordination with the Shallow Limy site. The Loamy Plains ecological site occurs on relatively flat ridges, plains, and only occasionally on moderately steep side slopes. This site is located where extra moisture from drainage or overflow is not received, and therefore produces runoff to areas lower on the landscape.
R073XY101KS	**Limy Slopes** The Limy Slopes ecological site is commonly located adjacent to or in coordination with the Shallow Limy site.

Table 1. Dominant plant species

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

Physiographic features

The western half of MLRA 73 and areas along the Arkansas River have remnants of the Tertiary river-laid sediments washed out onto the plains from erosion of the prehistoric Rocky Mountains in Colorado. In the valley of the Arkansas River, the wind reworked these sediments, forming a hummocky dune surface of eolian sand. A loess mantle occurs on the higher ground in the western half of the area. The Tertiary-age Ogallala and White River Formations cover Cretaceous Pierre Shale in the northern part of the area. The Ogallala Formation consists of loose to well cemented sand and gravel, and the White River Formation consists of ashy claystone and sandstone. Pierre Shale and Niobrara Chalk are at the surface in the valleys of the Republican, Smoky Hill, and Saline Rivers. Fort Hays limestone of the Niobrara Formation and Blue Hill shale of the Carlile Formation are at the surface in the valleys of the Saline and Smoky Hill Rivers. Shale can be seen exposed in the eastern half of this MLRA, in Kansas. Quaternary and more recent sand and gravel partially cover the shale in the river valleys.

The principal parent material of the Shallow Limy site is calcareous loamy residuum weathered from limestone, sandstone, siltstone, shale or chalk.

The Shallow Limy ecological site occurs on nearly level to very steep uplands (including vertical rock faces). This site produces runoff to areas lower on the landscape.

This site is subject to severe erosion by water if the vegetative cover is reduced or absent by such things as continuous defoliation without periodic rest and fire events. Vehicular traffic on this site is very limited to impossible.

A primary identifying feature for this site is the presence of calcium carbonate throughout the soil profile and as well as a soil depth of less than 20 inches.

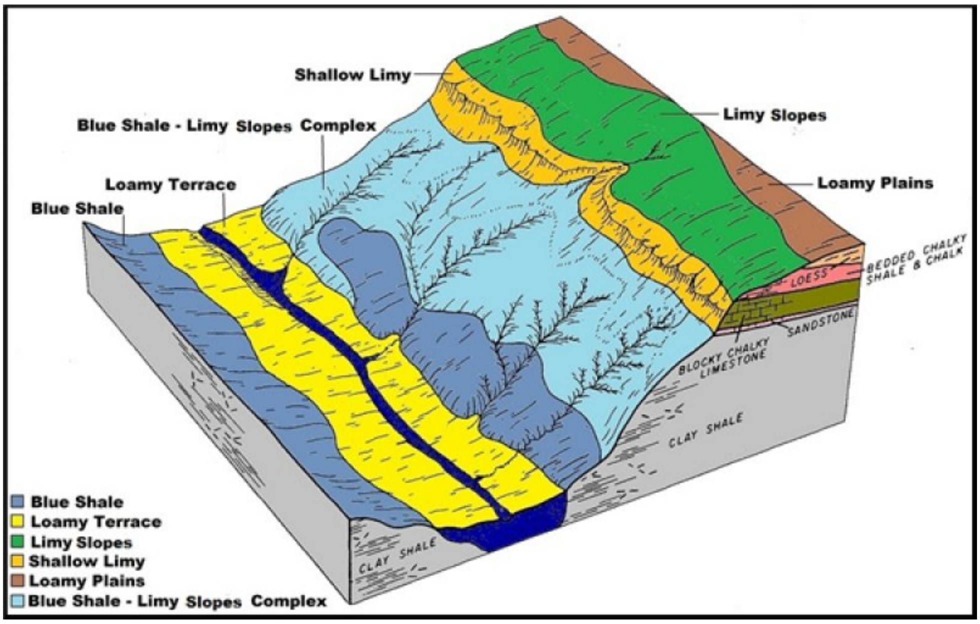


Figure 2. MLRA 73 ecological site block diagram.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Plain

Flooding frequency	None
Ponding frequency	None
Elevation	2,000–3,000 ft
Slope	2–60%
Ponding depth	0 in
Water table depth	60–80 in

Climatic features

For MLRA 73 the average annual precipitation is 19 to 30 inches (48 to 76 centimeters). Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The maximum precipitation occurs from the middle of spring to the early autumn months. Precipitation in winter occurs as snow. The annual snowfall ranges from about 17 inches (45 centimeters) in the southern part of the area to 24 inches (60 centimeters) in the northern part. The average annual temperature is 48 to 56 degrees F (9 to 14 degrees C). The freeze-free period averages 180 days and ranges from 145 to 210 days, increasing in length from northwest to southeast. The following weather data originated from weather stations chosen across the geographical extent of the ecological site, and will likely vary from the data for the entire MLRA. The climate data derives from the Natural Resources Conservation Service (NRCS) National Water and Climate Center. The data-set is from 1981-2010.

Table 3. Representative climatic features

Frost-free period (average)	152 days
Freeze-free period (average)	171 days
Precipitation total (average)	25 in

Climate stations used

- (1) NESS CITY [USC00145692], Ness City, KS
- (2) FRANKLIN #2 [USC00253037], Bloomington, NE
- (3) SMITH CTR [USC00147542], Smith Center, KS
- (4) JETMORE 8NNW [USC00144087], Jetmore, KS
- (5) OBERLIN [USC00145906], Oberlin, KS
- (6) ALTON 1 W [USC00140201], Alton, KS
- (7) PLAINVILLE 4WNW [USC00146435], Plainville, KS
- (8) WAKEENEY [USC00148495], Wakeeney, KS

Influencing water features

There are no water features of the Shallow Limy ecological site or adjacent wetland/riparian regimes that influence the vegetation and/or management of the site which make it distinctive from other ecological sites.

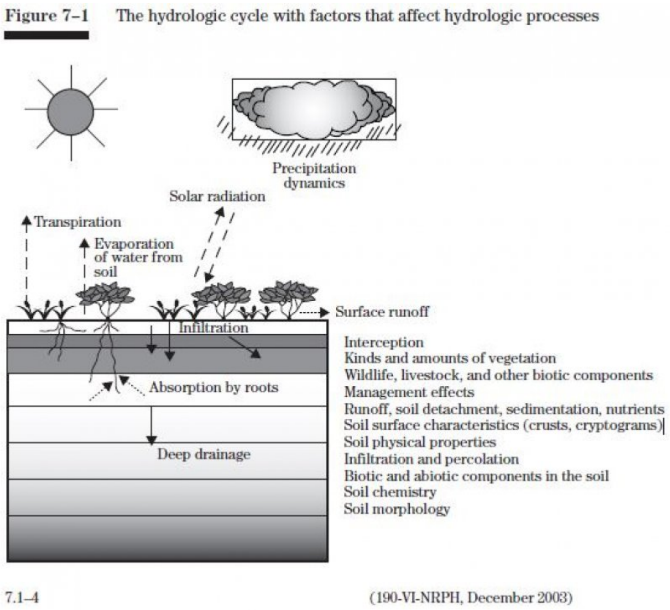


Figure 7. Fig.7-1 from National Range & Pasture Handbook.

Soil features

The soils on this site range from 10 to 20 inches deep over caliche or fractured bedrock. These soils have loamy surface layers and subsoils. These soils are well drained and somewhat excessively drained. They are calcareous throughout and have very low to low available water capacity. Inclusions of soils with less than 10 inches of material over caliche or bedrock are common. Vertical rock faces are common and slopes range from 1 to 50 percent. Soils in this site generally have moderately low organic matter content.

The major soil series which characterize the Shallow Limy ecological site are Canlon, Canyon, Heizer, Kipson, and Nibson.

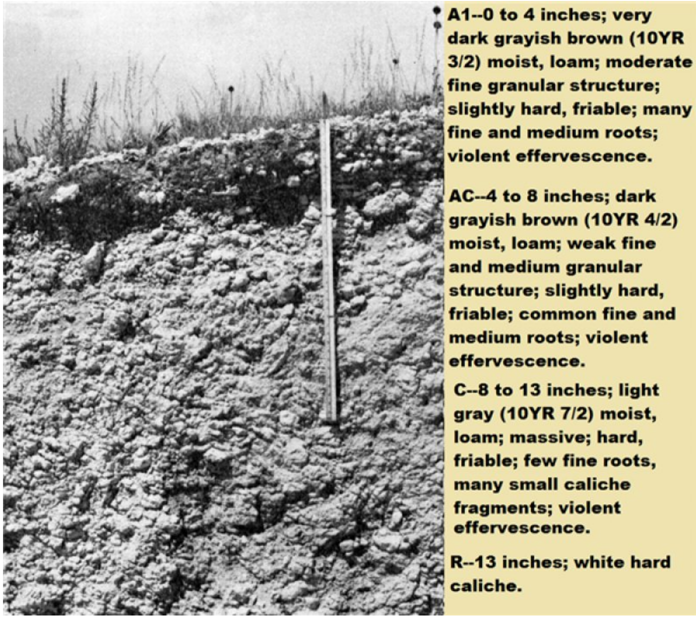


Figure 8. Canlon soil series profile Lane Cty. KS, 1972.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone and sandstone
Surface texture	(1) Loam (2) Gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat poorly drained
Permeability class	Very slow to moderately rapid
Soil depth	0–20 in
Surface fragment cover <=3"	0–35%
Surface fragment cover >3"	0–15%
Available water capacity (0-40in)	1.3–4.4 in
Calcium carbonate equivalent (0-40in)	0–65%
Electrical conductivity (0-40in)	0–1 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	7.7–8.3
Subsurface fragment volume <=3" (Depth not specified)	0–60%

Subsurface fragment volume >3" (Depth not specified)	0–25%

Ecological dynamics

The grasslands of Major Land Resource Area (MLRA) 73, the Rolling Plains and Breaks, located in south-central Nebraska and central Kansas, evolved under sub-humid (20-40 inch precipitation range) climates, characterized by much the same weather extremes of temperatures, rainfall, and snowfall we are familiar with today. As a result of glacial activity and other natural forces, then and later, plants have migrated from their places of origin, so that today MLRA 73 grasslands are simple-to-complex mixtures of perennial grasses and forbs, plus a few native annuals and biennials. Species composition has been modified by the introduction of Kentucky bluegrass and cool-season annual and perennial grasses, particularly Japanese brome (Launchbaugh and Owensby, 1978).

Through the ages to modern times, wildfires – many started by lightning, but most by primitive people – influenced development of fire-tolerant grasses and suppressed woody vegetation (Sauer, 1950). Certain woody plants, however, always were present as natural components of some grasslands. Browsing by animals and frequent prairie fires were largely responsible for maintaining “normal” amounts of woody species (Dyksterhuis, 1958). In primitive time, numerous large herbivores subjected herbaceous vegetation to grazing stress. After the last glacial retreat, bison emerged as the major dominant large grazer, although the prairies and plains simultaneously supported many pronghorn antelope, elk, deer, prairie dogs, rabbits, rodents, and insects. And each exerted grazing pressures on the vegetation (Launchbaugh and Owensby, 1978). There is little doubt that during and long before Spanish explorations into this area, most of the grassland was used almost continuously throughout the year by one roving herd of buffalo after another and other grazing animals (early exploration accounts reviewed by Dary in 1974; diaries of early Kansas residents cited by Choate and Fleharty in 1975). Grazing and trampling by bison and their associates were often intensive, as was uncontrolled grazing by livestock in the late 1800s after most of the wild grazers had been eliminated.

The plant communities for the Shallow Limy ecological site are dynamic due to the complex interaction of many ecological processes. The interpretive plant community for this site is the Reference Plant Community. The Reference Community has been determined by the study of rangeland relic areas, areas protected from excessive disturbance, areas under long term rotational grazing strategies, literature of plant communities from the early 1900s, and local expertise. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

This ecological site is made up of a Grassland State, a Woody State, and a Shortgrass State. The Grassland State is characterized by non-broken land (no tillage), both warm- and cool-season bunchgrasses, sod-forming grasses, forbs, and shrubs. The Woody State is characterized by a community made up of primarily eastern redcedar and/or locust, with few remnant native grasses making up the understory and very few forbs. The Shortgrass State is made up of a community of warm-season, short, sod, and bunchgrasses.

Vegetation changes are expected within this ecological site and will be dependent on the site's geographical location inside Major Land Resource Area (MLRA) 73. Variation in precipitation east and west is not as affected as is temperature north and south. The northern part of MLRA 73 is characterized by cooler temperatures and shorter growing season in respect to the southern end. As a result, cool-season bunchgrasses and sod-formers proliferate. Growth of native cool-season plants begins about April 15, and continues to about June 15. Native warm-season plants begin growth about May 15, and continue to about August 15. Green-up of cool-season plants may occur in September and October if adequate moisture is available (weather data from National Climate Data Center 1980-2010).

The Shallow Limy ecological site developed with occasional fires as part of the ecological processes. Historically, it is believed that the fires were infrequent, randomly distributed, and started by lightning at various times throughout the season when thunderstorms were likely to occur. It is also believed that pre-European inhabitants may have used fire as a management tool for attracting herds of large migratory herbivores (bison, elk, deer, and pronghorn). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool in the sub-humid, High Plains and Smoky Hills area.

The degree of herbivory (feeding on herbaceous plants) has a significant impact on the dynamics of the site. Historically, periodic grazing by herds of large, migratory herbivores was a primary influence. Secondary influences of herbivory by species such as prairie dogs, grasshoppers, gophers, and root-feeding organisms impacted the vegetation historically, and continue to this day.

The management of herbivory by humans through grazing of domestic livestock and/or manipulation of wildlife populations has been a major influence on the ecological dynamics of the site. This management, coupled with the High Plains and Smoky Hills climate, largely dictates the plant communities for the site.

Drought cycles were part of the natural range of variability within the site and historically have had a major impact upon the vegetation. The species composition changes according to the duration and severity of the drought cycle (Albertson and Weaver, 1940).

The Shallow Limy ecological site is generally on the breaks of the hills between the uplands and valleys. Much of the site is steep and associated with rock ledges forming vertical drops. The more level portions, usually just above the break of the hills, are generally grazed rather heavy. Water locations, salt placement, and other aids help to distribute grazing. Other management techniques such as concentrated grazing and/or grazing systems also help to distribute grazing more evenly.

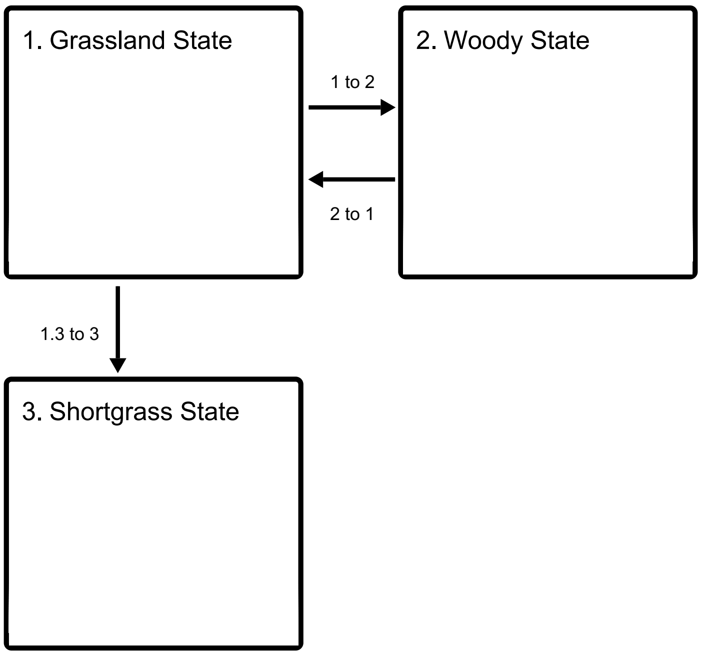
The general response of the Shallow Limy ecological site to long-term, heavy, continuous grazing pressure is to gradually lose the vigor and reproductive potential of the tall- and mid-grass species and shift the plant community toward midgrass, shortgrass, and/or cool-season species.

On the steeper, less accessible areas, the preferred grass species generally escape excessive grazing pressure. This feature provides a source for the more desirable forage plants after long periods of drought and/or overgrazing.

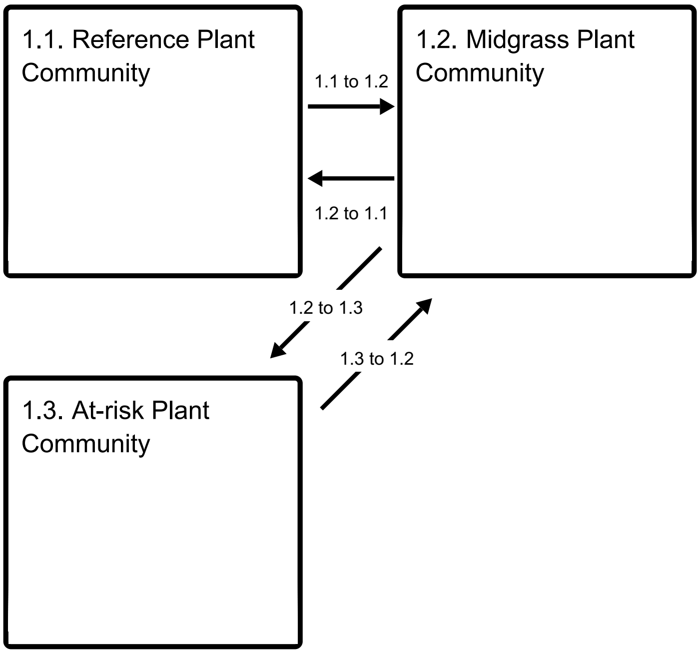
The following diagram illustrates pathways that the vegetation on this site may take, within the Grassland Reference State and beyond, as influencing ecological factors change. There may be other states or plant communities not shown in the diagram, as well as noticeable variations within those illustrated and described in the following sections.

State and transition model

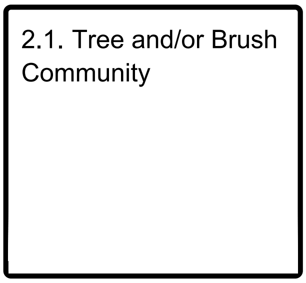
Ecosystem states



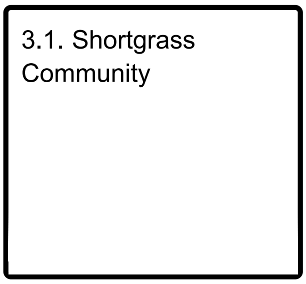
State 1 submodel, plant communities



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 Shallow Limy 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. These events are part of the natural disturbance regime and climatic process. The Reference Plant Community consists (73 percent) of warm-season tall- and midgrass species. The midgrass plant community is made up primarily of warm-season midgrasses and decreasing amounts of forbs. The At-Risk plant community is dominated by shortgrasses with remnant warm-season midgrasses.

Community 1.1
Reference Plant Community

Figure 9. Shallow Limy ecological site.

Figure 10. Landscape photo of Shallow Limy.

This plant community expresses the key vegetative characteristics of the Reference State. The Reference Plant Community is supported by empirical data, historical data, local expertise, and photographs. The potential vegetation consists of 49% midgrasses, 26% tallgrasses while shortgrasses make up a minor (8%) component of the plant community. A trace component (2%) of cool-season grasses, followed by a subdominant (13%) component of forbs and shrubs (2%) make up the remainder of the Reference Plant Community composition by weight. Plant species in the dominant midgrass plant group include sideoats grama, little bluestem, and plains muhly. Plant species in the subdominant tallgrass group includes big bluestem, switchgrass, Indiangrass, composite dropseed, and sand dropseed. Plant species in the shortgrass component are blue grama, hairy grama, and buffalograss. This plant community has a diverse forb population with the more prevalent forbs being blacksamson echinacea, dotted blazing star, violet prairie clover, and Nuttall's sensitive-briar. This plant community is highly productive, diverse, and resistant to short-term (<4 years) stresses, such as drought, continuous heavy stocking, or non-use by grazing animals. This plant community is resilient when proper management includes adequate rest and recovery periods between grazing events and the use of prescribed fires. Total annual production ranges from 1,000 to 2,500 pounds of air-dried vegetation per acre per year and will average 1,750 pounds. These production figures are the fluctuations expected during favorable, normal, and unfavorable years due to the timing and amount of precipitation and temperature. Total annual production should not be confused with individual species productivity, which is annual production and variability by species throughout the extent of the community phase.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	830	1485	2135
Forb	170	225	275
Shrub/Vine	0	40	90
Total	**1000**	**1750**	**2500**

Figure 12. Plant community growth curve (percent production by month).
KS7301, Big Bluestem, Little Bluestem, Sideoats Grama.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	8	25	30	25	10	2	0	0	0

Community 1.2
Midgrass Plant Community

This plant community defines a shift in plant composition, function, and structure from that of the reference plant community to a midgrass plant community with the once subdominant tallgrass group moving to a minor (<10%) component. The tallgrass big bluestem is decreasing in composition and vigor with continuous defoliation. Little bluestem is a midgrass that is increasing in composition, production, and vigor. Big bluestem will be replaced by a dominance of little bluestem, sideoats grama, and blue grama. Dominant plants in this community phase include little bluestem and sideoats grama. There could be a potential increase in blue grama, hairy grama, western wheatgrass and threadleaf sedge. If established woody species are present they will continue to increase in composition with no implementation of prescribed fire. Timing of defoliation (grazing, wildfire, hail, etc.) will have an impact on the proportions of species within the community such as western wheatgrass, needleandthread, and sedge species. Due to a decrease in plant litter, the effective precipitation is reduced, causing a decline in total annual production compared to the Reference Plant Community. The total average annual production of this site is approximately 1,650 pounds per acre (air-dry weight).

Community 1.3
At-risk Plant Community

The At-Risk Plant Community is vulnerable to degradation and to exceeding the resilience limits of the Grassland State and transitioning to the Shortgrass State. The At-Risk community phase is considered to be a stage in a transition process that is reversible if management is changed. This plant community defines a shift in plant composition, function, and structure from that of a midgrass community to a shortgrass plant community. Midgrasses, such as little bluestem and sideoats grama, are decreasing in composition, production, and vigor with continuous defoliation. Midgrasses will be replaced by the shortgrasses blue grama and buffalograss, and western wheatgrass as a cool-season midgrass. The dominant plants in this community phase include blue grama, hairy grama, buffalograss with remnant western wheatgrass, sideoats grama, and little bluestem. Increased grazing pressure will further reduce midgrass species, shifting the plant community toward a more sod-bound blue grama and buffalograss condition. Timing of defoliation (grazing, wildfire, hail, etc.) will have an impact on the proportions of species within the community such as western wheatgrass, needleandthread, and sedge species. Due to a decrease in plant litter, the effective precipitation is reduced, causing a decline in total annual production compared to the midgrass plant community. Forb diversity has drastically decreased. The shrub species present will depend upon the location within the MLRA. Broom snakeweed, western snowberry, and prickly pear will be the dominant shrub species in the western portion of the MLRA, and sumac species will be more common in the eastern portion. Dependent upon establishment and use of prescribed fire, woody species could be at infestation levels greater than 15%. The total average annual production of this site is approximately 1,150 pounds per acre (air-dry weight).

Pathway 1.1 to 1.2
Community 1.1 to 1.2

The following describes the mechanisms of change from plant community 1.1 to plant community 1.2. 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 for periods greater than 10 years will shift functional and structural plant group dominance towards plant community 1.2.

Pathway 1.2 to 1.1
Community 1.2 to 1.1

The following describes the mechanisms of change from plant community 1.2 to plant community 1.1. Management (10-15 years) that includes adequate rest and recovery during the growing season of the key forage species (big bluestem, little bluestem, and sideoats grama) within the Reference Plant Community. If woody species are present, prescription fires every 4-6 years will be necessary for their removal and/or maintenance.

Pathway 1.2 to 1.3
Community 1.2 to 1.3

The following describes the mechanisms of change from plant community 1.2 to plant community 1.3. Long term (>10years) management that includes continuous, heavy use of the native vegetation. Management void of a forage and animal balance, and inadequate rest and recovery of native grasses during the growing season.

Pathway 1.3 to 1.2
Community 1.3 to 1.2

The following describes the mechanisms of change from plant community 1.3 to plant community 1.2. Management (approximately 10 years) that includes adequate rest and recovery of the key forage species in the midgrass community 1.2 (little bluestem and sideoats grama). Implement prescription fires at a frequency of 6-8 years. Dependent upon the level of woody vegetation encroachment, the fire return interval might need adjusted to two consecutive years of prescribed fires.

State 2
Woody State

This state is dominated by a tree and/or shrub plant community. The increase and spread of trees results from an absence of fire. Woody plants can increase up to 34% from a lack of fire according to a study from 1937 to 1969, in contrast to a 1% increase on burned areas (Bragg and Hulbert, 1976). Periodic burning tends to hinder the establishment of most woody species and favors forbs and grasses. However, it should be pointed out that not all unburned areas have a woody plant invasion. Hydrologic function is affected by the amount of vegetative cover. Canopy interception loss can vary from 25.4% to 36.7% (Thurow and Hester, 1997). A small rainfall event is usually retained in the foliage and does not reach the litter layer at the base of the tree. Only when canopy storage is reached and exceeded does precipitation fall to the soil surface. Interception losses associated with the accumulation of leaves, twigs, and branches at the base of trees are considerably higher than losses associated with the canopy. The decomposed material retains approximately 40% of the water that is not retained in the canopy (Thurow and Hester, 1997). Soil dynamic property changes affected include biological activity, infiltration rates, and soil fertility. Special planning will be necessary to assure that sufficient amounts of fine fuel are available to carry fires with enough intensity to control woody species. In some locations the use of chemicals as a brush management tool may be desirable to initiate and accelerate this transition. Birds, small mammals, and livestock are instrumental in the distribution of seed and accelerating the spread of most tree and shrubs common to this site. The speed of encroachment varies considerably and can occur on both grazed and non-grazed pastures. Many species of wildlife, especially bobwhite quail, turkey, and white-tailed deer benefit from the growth of trees and shrubs for both food and cover. Conversely, the presence of trees is considered detrimental to populations of greater prairie chickens. When management for specific wildlife populations is desirable, these options should be considered in any brush management plan.

Community 2.1
Tree and/or Brush Community

This community is dominated by trees with a canopy cover usually greater than 15-20%. Trees characterizing this community include eastern redcedar and honeylocust. When tree encroachment occurs on areas that have been subjected to long-term continuous overgrazing, the associated grasses will usually consist of composite dropseed, purpletop tridens, purple lovegrass, Kentucky bluegrass, and Scribner's rosette grass. Trees will also invade areas where both grazing and fire have been excluded for many years. A heavy accumulation of plant mulch and litter retards herbage growth. This provides a favorable habitat for seed germination and establishment of many woody species. Grass yields are significantly decreased by 10 to 30 percent of the total vegetative production, due to the competition from woody species. The combination of less water entering the soil and strong ability by the trees to extract water, means that little water has a chance to drain beneath the root zone. Therefore, invasion of trees (primarily juniper) and shrubs on large areas that were once primarily grassland has strong implications for recharge of aquifers. It can be a common occurrence to have seeps and springs stop flowing in conjunction with increases in tree and shrub cover (Thurow and Hester, 1997). In this plant community, the amount of available forage is heavily dependent upon the predominant woody species cover and the kind(s) of livestock and/or wildlife utilizing the site. A prescribed burning program, mechanical brush removal, and periodic rest and recovery accompanied by prescribed grazing can return the plant community to one dominated by grasses and forbs. The time frame will be dependent upon the canopy cover percentage and remnant native grass population remaining. Special planning will be necessary to assure that sufficient amounts of fine fuel are available to carry fires with enough intensity to control woody species. Use of labeled herbicides and mechanical removal as a brush management tool will usually be necessary to reduce fire-resistant populations like honeylocust in order to accelerate the recovery of desired vegetative cover. Some landowners rely on the browsing habits of goats to suppress the woody growth.

State 3
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. Species diversity has been reduced further. Water infiltration is reduced and runoff is increased due to the sod nature of the buffalograss and blue grama. Specific dynamic soil property 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).

Community 3.1
Shortgrass Community

The potential vegetation is a shortgrass prairie. Blue and hairy grama and buffalograss are the dominant grasses in this community. Western wheatgrass decreases. Little bluestem, sideoats grama and other midgrasses exist only as remnants. Tallgrasses are rarely found. Annual forbs, annual grasses, and shrubs will increase. This plant community is resistant to change due to grazing and drought tolerance of blue grama, hairy grama, and buffalograss. A significant amount of production and diversity has been lost when compared to the Reference Plant Community. Loss of tall- and midgrass warm-season grasses, cool-season grasses, shrub component and nitrogen fixing forbs have impacted the energy flow, nutrient cycling, and water cycle. Water infiltration is reduced due to the massive shallow root system, or “root pan," characteristic of sod-bound blue grama and buffalograss. Soil deposition from water may be noticeable on the steeper slopes where flow paths are connected. Blue grama provides this site with a unique feature in that the leaves on blue grama remain semi-dormant during drought periods but resume growing each time adequate moisture is available during the growing season. Reseeding of blue grama is unlikely because young seedlings seldom survive the extended drought periods that are common on this site. Blue grama does maintain itself by tillering. This also provides blue grama with another unique feature of being able to withstand drought and heavy grazing use. Typically blue grama is a bunchgrass but quickly forms a sod-bound condition when heavily grazed. The total average annual production of this site is approximately 550 pounds per acre (air-dry weight).

Transition 1 to 2
State 1 to 2

Changes from a Grassland State to a Woody State lead to changes in hydrologic function, forage production, dominant functional and structural groups, and wildlife habitat. Understory plants may be negatively affected by trees and shrubs by reductions in light, soil moisture, and soil nutrients. Increases in tree and shrub density and size have the effects of reducing understory plant cover and productivity, with desirable forage grasses often being most severely reduced (Eddleman, 1983). As vegetation cover changes from grasses to trees, a greater proportion of precipitation is lost throughout interception and evaporation; therefore, less precipitation is available for producing herbaceous forage or for deep drainage or runoff (Thurow and Hester, 1997). Tree and shrub establishment becomes increasingly greater while fine fuel loads decrease. As trees and shrubs increase at levels of greater than 20 percent canopy cover, the processes and functions that allow the Woody State to become resilient are active and dominate over the processes and systems inherent of the Grassland State. Using prescription fire as a standalone management tool is unsuccessful to eradicate the trees and shrubs due to a lack of fine fuel loads.

Transition 1.3 to 3
State 1 to 3

Long-term management (~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, hairy grama, and buffalograss sod. Drought, in combination with this type of management, will quicken the rate at which this transition occurs. Ecological processes effected are the hydrologic and nutrient cycles. Increased evaporation rate, an increase in runoff, an increase in bulk density, a decrease in infiltration, changes in plant composition, and functional and structural group shifts are examples of soil and vegetation properties that have compromised the resilience of the Grassland State and transitioned to a Shortgrass State.

Restoration pathway 2 to 1
State 2 to 1

Restoration efforts will be costly, labor-intensive, and can take many years, if not decades, to return to a Grassland State. Once canopy levels reach greater than 20 percent, the estimated cost to remove trees is very expensive and includes high energy inputs. The technologies needed in order to go from an invaded Woody State to a Grassland State include but are not limited to: prescribed burning—the use of fire as a tool to achieve a management objective on a predetermined area under conditions where the intensity and extent of the fire are controlled; brush management—manipulating woody plant cover to obtain desired quantities and types of woody cover and/or to reduce competition with herbaceous understory vegetation, in accordance with overall resource management objectives; prescribed grazing—the controlled harvest of vegetation with grazing or browsing animals managed with the intent to achieve a specified objective. Grazing at an intensity that will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation. When a juniper tree is cut and removed, the soil structure, and the associated high infiltration rate may be maintained for over a decade (Hester, 1996). This explains why the area near the dripline usually has substantially greater forage production for many years after the tree has been cut. It also explains why runoff will not necessarily dramatically increase once juniper is removed. Rather, the water continues to infiltrate at high rates into soils previously ameliorated by junipers, thereby increasing deep drainage potential. In rangeland, deep drainage amounts can be 16 percent of the total rainfall amount per year (Thurow and Hester, 1997).

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	**Warm-season midgrass dominant 49%**			400–850	
	little bluestem	SCSC	*Schizachyrium scoparium*	425–785	

	little bluestem	SCSC	*Schizachyrium scoparium*	435–785	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	85–260	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–85	–
2	**Warm-season tallgrass subdominant 26%**			200–450	
	big bluestem	ANGE	*Andropogon gerardii*	260–500	–
	switchgrass	PAVI2	*Panicum virgatum*	0–85	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–85	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–35	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–35	–
3	**Warm-season shortgrasses minor 8%**			50–145	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–85	–
	blue grama	BOGR2	*Bouteloua gracilis*	25–85	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–85	–
4	**Cool-season grasses trace 2%**			0–35	
	threadleaf sedge	CAFI	*Carex filifolia*	0–35	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–35	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–15	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–15	–
Forb					
5	**Forbs subdominant 13%**			100–230	
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	15–85	–
	dotted blazing star	LIPU	*Liatris punctata*	15–85	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	10–50	–
	purple prairie clover	DAPU5	*Dalea purpurea*	10–50	–
	stiff goldenrod	OLRIR	*Oligoneuron rigidum var. rigidum*	0–35	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	5–35	–
	sticky skullcap	SCRE3	*Scutellaria resinosa*	0–35	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–35	–
	scarlet	SPCO	*Sphaeralcea coccinea*	0–35	–

	globemallow				
	stemless four-nerve daisy	TEACA2	*Tetraneuris acaulis var. acaulis*	0–35	–
	roundleaf bladderpod	LEOV	*Lesquerella ovalifolia*	0–35	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	5–35	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	5–35	–
	lavenderleaf sundrops	CALA38	*Calylophus lavandulifolius*	0–35	–
	white prairie clover	DACA7	*Dalea candida*	5–35	–
	plains milkweed	ASPU	*Asclepias pumila*	0–15	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–15	–
Shrub/Vine					
6	**Tree and/or brush trace 2%**			0–40	
	leadplant	AMCA6	*Amorpha canescens*	0–50	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–35	–
	smooth sumac	RHGL	*Rhus glabra*	0–35	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–35	–
	soapweed yucca	YUGL	*Yucca glauca*	0–35	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–15	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–15	–

Animal community

Wildlife Interpretations

This ecological site is on the sides and narrow tops of upland ridges that are dissected by deeply entrenched drainageways. Slopes can range from 0 to 30 percent and often contain rocky outcrops. The shallow soils and steep slopes make farming this site difficult, if not impossible, leaving the majority of these sites in native vegetation.

Historically, the predominance of grasses and forbs on this site supported grazers and mixed feeders such as bison, elk, deer, and pronghorn and a variety of grassland-associated birds and small mammals. Due to the heterogeneity inherent in all landscapes, some areas were not grazed uniformly by these historic large herds of grazing animals. This type of grazing enhanced habitat for wildlife by creating a mosaic pattern, or patchiness, of vegetative structural diversity throughout the landscape. Wildlife native to the site depend on a plant community diverse in species and structure. This need is evident in the variability of known habitat requirements of grassland-associated wildlife.

Adjacent sites that are more productive are often preferred by grazing animals. This can lead to overgrazing on this site due to the lower productivity and fragile nature of the soils, especially under continuous grazing systems.

Small soapweed, skunkbrush sumac, and leadplant may be present and locally abundant on this site. Skunkbrush sumac offers escape and thermal cover for several species of wildlife. Undisturbed sites are at risk from tree invasion from species such as eastern redcedar. Limestone outcroppings are common on this site and provide specialized habitat for many species not found elsewhere.

The site's general close proximity to permanent or seasonal water in streams generally meets the needs of wildlife requiring open water for drinking. Seasonal pools present in these drainageways during the spring offer breeding habitat for amphibians.

Periodic events such as prolonged drought, wildfire, disease, or high insect numbers will alter plant community diversity and structure and associated wildlife species. Plant community structure is highly dependent on rainfall since the water-holding capacity of the site is very low.

Little Bluestem, Big Bluestem, and Sideoats Grama Reference Plant Community

The high diversity of grasses and forbs in this community provides habitat for a diverse group of insects. These sites often have very diverse forb populations. Areas with high forb diversity will generally support more insects such as the leaf-hoppers important to young grassland-nesting birds. Grasshoppers, associated with grasses, are a critical food source for birds in later stages of development. Reptiles such as the prairie lizard and the Great Plains rat snake can often be found in the limestone outcroppings common to this site. Rock outcroppings also provide nesting sites for ferruginous hawks that feed on pocket gophers and prairie dogs that inhabit nearby upland sites. Rock crevices can be potential roost sites for a bat called the small-footed myotis. Rock wrens may also use these areas to nest.

Animal Community – Grazing Interpretations

Historical overgrazing has been the key element that has affected the declining condition on many range sites. It is during periods of overstocking that many of the preferred species are taken out of these sites, reducing production, vigor, and diversity. Many new grazing systems are being tested and tried, utilizing stocking rates, timing, stocking density, positive animal impacts, and other factors to enhance ecological site condition.

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 desirability 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

Water is the principal factor limiting forage production on this site. Infiltration and runoff potential for this site varies from low to high. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff.

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other opportunities. The wide varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors. The sloping portions of this site provide a colorful and rustic landscape desired by many people. The less sloping portions are often used for cropland.

Wood products

No appreciable wood products are present on the site.

Other products

None noted

Other information

Site Development and Testing Plan: This ESD finished the approval process.

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 were used extensively to develop this ecological site description.

NRCS individuals involved in developing the Loamy Plains ESD in 2002 include: Darrell Beougher, Jon Deege, Lorne Denetclaw, Sharla Schwien, Joel Willhoft, Dwayne Rice, and Bob Tricks from Kansas; and Nadine Bishop, Kristin Dickinson, Kim Stine, Dana Larson, and Chuck Markley from Nebraska.

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Contributors

Chris Tecklenburg

Approval

David Kraft, 10/02/2019

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 3-13-2017 David Kraft, John Henry, Doug Spencer and Dwayne Rice Original Authors 02-2005
Contact for lead author	Chris Tecklenburg (chris.tecklenburg@ks.usda.gov)
Date	10/01/2019
Approved by	David Kraft
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:** Typically none. If present (steeper slopes following intense storms) short and not connected.

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3. **Number and height of erosional pedestals or terracettes:** None, due to the amount of cover. Pedestals and terracettes are indicators of soil being moved by water and/or wind.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 10% bare ground is found on this site, with bare patches generally less than 2-3 inches in diameter. Extended drought can cause bare ground to increase. Bare ground is the remaining ground cover after accounting for ground surface covered by vegetation (basal and foliar canopy), litter, standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

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5. **Number of gullies and erosion associated with gullies:** None. There are no channels that are being cut into the soil by moving water. Gullies are not a natural feature of this landscape and site.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None. The vegetative cover in the Reference State is sufficient to limit wind-scoured or blowout areas. This site is not a depositional area for offsite wind erosion.

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7. **Amount of litter movement (describe size and distance expected to travel):** None. The inherent capacity for litter movement on a soil is a function of its slope and landscape position.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant canopy is large enough to intercept the majority of

raindrops. The soil characteristic of this site is resistant to erosion. No physical crusts apparent. Soil stability scores will range from 5-6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Canlon Series
A1--0 to 4 inches; very dark grayish brown (10YR 3/2) moist, loam; moderate fine granular structure; slightly hard, friable; many fine and medium roots; violent effervescence; moderately alkaline.
AC--4 to 8 inches; dark grayish brown (10YR 4/2) moist, loam; weak fine and medium granular structure; slightly hard, friable; many 1/4 to 1 1/2-inch caliche fragments; violent effervescence.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Diverse grass, forb, shrub canopy and root structure reduces raindrop impact and slows overland flow providing increased time for infiltration to occur.

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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 compacted soil layers due to cultural practices. Soil structure is conducive to water movement and root penetration.

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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 Warm-season midgrasses dominant 49%. Little bluestem 435-785, sideoats grama 85-260, plains muhly 0-85.

Sub-dominant: Group 2 Warm-season tallgrasses subdominant 26%. Big bluestem 260-500, switchgrass 085, Indiangrass 0-85, composite dropseed 0-35, sand dropseed 0-35

Other: Group 3 Warm-season shortgrasses minor 8%. Blue grama 25-85, buffalograss 0-85, hairy grama 0-85.

Additional: Group 4 Cool season grasses trace 2%.

Group 5 Subdominant forb component 13%.
Group 6 Shrubs and cacti Trace component 2%.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** The majority of plants are alive and vigorous. Some mortality and decadence is expected for the site. This in part is due to drought, unexpected wildfire or a combination of the two events. This would be expected for both dominant and sub-dominant groups.

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14. **Average percent litter cover (%) and depth (in):** Plant litter is distributed evenly throughout the site.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1,000-2,500 lbs/acre. Representative value is 1750 lbs/forage/acre. Below normal precipitation during the growing season, expect 1000 lbs/forage/acre; and above normal precipitation during the growing season, expect 2500 lbs/forage/acre. If utilization has occurred, estimate the annual production removed or expected and include this amount when making the total site production estimate.

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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:** Invasive or noxious weeds should not occur in the Reference Community. However, cheatgrass, Russian thistle, kochia, and other non-native annuals can invade following extended drought, assuming a seed source is available.

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17. **Perennial plant reproductive capability:** The number and distribution of tillers or rhizomes is assessed on perennial plants occupying the evaluation area. No reduction in vigor or capability to produce seed or vegetative tillers given the constraints of climate and herbivory.