USDA Natural Resources Conservation Service

Ecological site R073XY103KS Subirrigated

Last updated: 9/30/2019
Accessed: 05/07/2024

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 Subirrigated ecological site occurs on nearly level to very gently sloping areas along drainageways of uplands and sand hills, below permanent springs, and on floodplains in valleys with high water tables. This site is subject to flooding except for positions on interdunes. The soils have a seasonal high water table within the root zone that limits the species capable of long-term survival within the site. This site receives runoff from areas higher on the landscape.

Associated sites

R073XY107KS	**Sandy Floodplain** The Subirrigated ecological site is commonly located adjacent to or in coordination with the Sandy Floodplain site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

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.

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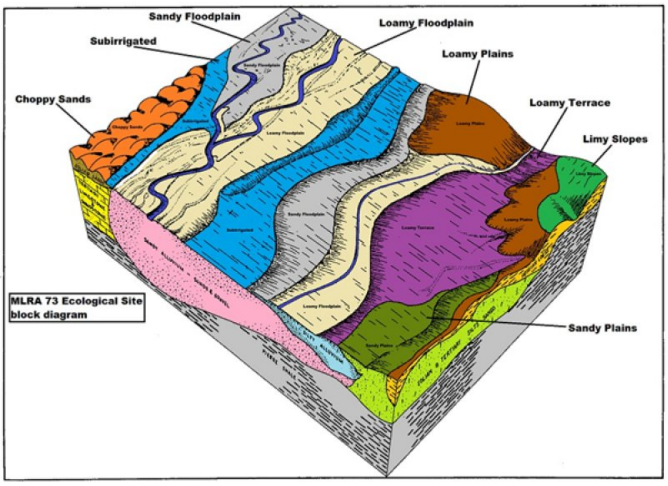


Figure 2. MLRA 73 Ecological Site block diagram.

Table 2. Representative physiographic features

Landforms	(1) Flood plain (2) Drainageway
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	None to occasional
Ponding frequency	None

Elevation	762–1,524 m
Slope	0–3%
Ponding depth	0 cm
Water table depth	30–107 cm

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)	151 days
Freeze-free period (average)	166 days
Precipitation total (average)	610 mm

Climate stations used

- (1) CAMBRIDGE [USC00251415], Cambridge, NE
- (2) HARLAN CO LAKE [USC00253595], Republican City, NE
- (3) OXFORD 6NNW [USC00256454], Oxford, NE
- (4) DODGE CITY [USW00013985], Dodge City, KS
- (5) HAYS 1 S [USC00143527], Hays, KS
- (6) FRANKLIN #2 [USC00253037], Bloomington, NE
- (7) RED WILLOW DAM [USC00257110], Mc Cook, NE

Influencing water features

Influencing water features on this ecological site include a water table less than 6 feet from the soil surface. This water table influences the kinds and amounts of vegetation, and the management of the site, making it distinctive from other ecological sites.

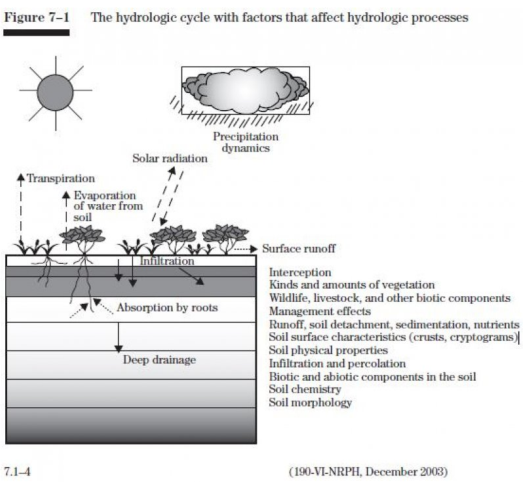


Figure 7. Fig.7-1 from National Range and Pasture Handbook.

Soil features

The soils in this site are predominantly somewhat poorly drained, but inclusions of moderately well to poorly drained soils occur within some of the listed series. These soils are generally very deep, but some are shallow over gravelly coarse sand. The surface soil is generally dark colored and ranges from 7 to 24 inches thick. Less common are light colored soils with a surface soil of less than 7 inches thick. Texture of the surface soil ranges widely from silt loam to fine sand. Organic matter content of the surface layer is generally moderate. The underlying material is lighter colored than the surface soil, and commonly has redoximorphic concentrations (soft masses of iron oxide) in the upper part. It ranges widely in texture from loam to gravelly course sand. Many soils in this site are calcareous at or near the surface.

Major soil series correlated to this ecological site include Alda, Caruso, Leshara, Platte, and Wann.

These attributes represent 0-40 inches in depth or to the first restrictive layer.

Ap--0 to 6 inches; very dark gray (10YR 3/1) moist, fine sandy loam; weak medium granular structure; soft, very friable.

A--6 to 16 inches; very dark gray (10YR 3/1) moist, fine sandy loam; weak coarse blocky structure parting to moderate medium granular; soft, friable; strong effervescence.

C--16 to 50 inches; grayish brown (10YR 5/2) moist, sandy loam; common medium distinct yellowish brown (10YR 5/4) moist masses of oxidized iron in the matrix; weak coarse prismatic structure; soft, friable; strong effervescence.

Cg--50 to 60 inches; dark gray (10YR 4/1) moist, sandy loam; single grain; loose; soft white masses of calcium carbonate above 52 inches; strong effervescence.

Figure 8. Wann soil series profile description.

Table 4. Representative soil features

Surface texture	(1) Sand (2) Fine sand (3) Loamy sand
Family particle size	(1) Sandy
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Moderately slow to rapid
Soil depth	152–203 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	10.06–38.05 cm
Calcium carbonate equivalent (0-101.6cm)	0–40%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–4
Soil reaction (1:1 water) (0-101.6cm)	7–8.7
Subsurface fragment volume <=3" (Depth not specified)	0–50%

Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

The grasslands of Major Land Resource Area (MLRA) 73, the Rolling Plains and Breaks, is located in south-central Nebraska and central Kansas. It 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 Subirrigated 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 Cool-Season State. The Grassland State is characterized by non-broken land (no tillage), warm-season bunchgrasses, sod forming grasses, forbs, and shrubs. The Woody State is characterized by a community made up of eastern redcedar, Siberian elm, Russian Olive, and cottonwood with few remnant native grasses making up the understory and forbs. The Cool-Season State is made up of a community of cool-season, mid-, sod-, and bunchgrasses. The Tillage State has been mechanically disturbed (broken) by equipment and includes either a variety of reseeded warm-season bunch and sod-forming grasses or early successional plants to include the latter as well as annual grasses and forbs.

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 Subirrigated 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).

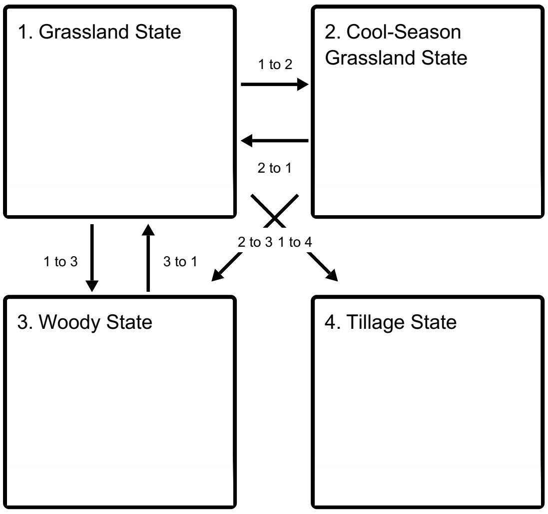
This site appears on the more level low areas along major drainageways. Due to the availability of water, the vegetation remains lush and green throughout the growing season. This attracts grazing animals to the site, creating a need for special grazing management techniques to prevent overgrazing.

The general response of this site to long-term continuous grazing pressure is to gradually lose the vigor and reproductive potential of the tall- and midgrass species, and shift the plant community toward cool-season species.

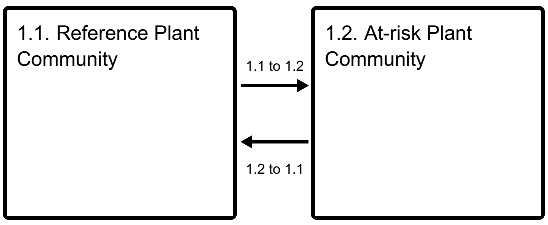
The following diagram illustrates pathways that the vegetation on this site may take from the Reference Plant Community as influencing ecological factors change. There may be other states or plant communities not shown in the diagram, as well as noticeable variations within those illustrated and described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

State and transition model

Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities

2.1. Cool-Season Community

State 3 submodel, plant communities

3.1. Tree-shrub Plant Community

State 4 submodel, plant communities

4.1. Reseed Community

4.2. Go-back Community

State 1
Grassland State

The Grassland State is supported by empirical data, historical data, local expertise, and photographs. This state is defined by two 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 of warm-season tall- and midgrasses, forbs, and shrubs. The At-risk Community consists of cool- and warm-season midgrasses, forbs, shrubs, annuals, and/or woody species.

Community 1.1
Reference Plant Community

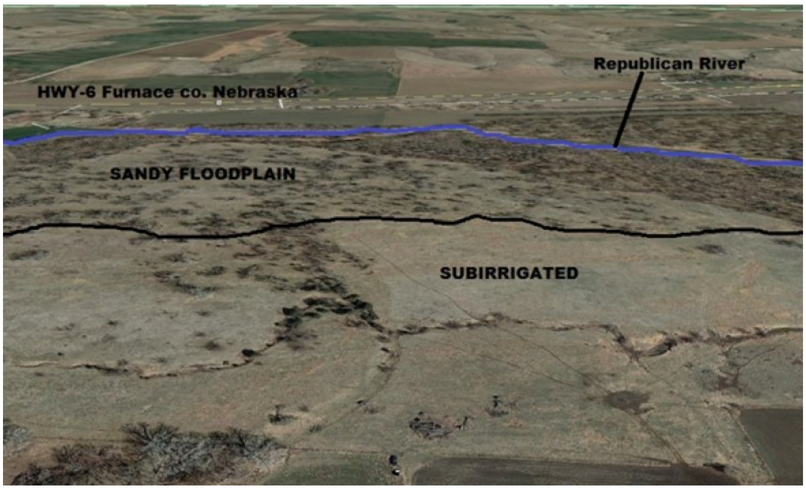


Figure 9. Subirrigated ecological site landform position.

The interpretive plant community for this site is the Reference Plant Community. The natural potential vegetation of this community is a mixed grass prairie. This community is comprised of 80-90 percent grasses and grass-like plants, 10-15 percent forbs, and 0-5 percent shrubs. Big bluestem, eastern gamagrass, switchgrass, prairie cordgrass, and Indiangrass are the dominant species in this community, making up 60% of the total annual production. A host of secondary cool-season species make up 10% of the total annual production, followed by 5% marm-season midgrasses, and 5% sedges and rushes. A very diverse subdominant forb population exists, making up 15% of the total annual production. Woody species are a minor component that makes up 5%. This community has historically been used for haying during midsummer and the grazing aftermath during the dormant season. This community is often used during the dormant season as winter grazing or a feeding area. American licorice and Canada thistle may increase where cattle are fed in the winter. This plant community is diverse and highly productive. The abundance and diversity of vegetation result from a water table less than 6 feet from the soil surface. The abundant vegetation allows for excellent capture and storage of precipitation as well. The abundance of plant litter, minimal shrub growth, and low mortality of plants contribute to the proper function of the water and mineral cycles. The amount of vegetation, high litter cover, and decomposition of roots contributes to the proper function of the nutrient cycle. Total annual production by growth form ranges from 4,000 (unfavorable year) to 5,500 (favorable year) pounds per acre of air-dry weight and will average 4,750 pounds (representative value). The fluctuations expected during the year are based on weather variability, primarily a result of timing and amount of precipitation and temperature. Total annual production by growth form should not be confused with 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 (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	3587	4259	4932
Forb	673	796	925
Shrub/Vine	224	269	308
Total	**4484**	**5324**	**6165**

Figure 11. Plant community growth curve (percent production by month). KS0007, Big Bluestem, Switchgrass, Indiangrass Plant Community . Growth of warm-season grasses on this site typically begins during the period of May 1 to May 15 and continues until mid-September. Cool-season grasses, sedges, and rushes generally have two primary growth periods, one in the fall (September and October) and again in the spring (April, May, and June). Some growth may occur in winter months during periods of unseasonably warm temperatures ("Indian summers.") 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..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	10	35	35	10	5	0	0	0

Community 1.2
At-risk Plant Community

The At-risk community phase is vulnerable to degradation. It is most vulnerable to exceeding the resilience limits of the state and transitioning to an alternative state. This community phase is considered to be a stage in a transition process that is reversible if management is changed. This plant community is dominated by cool-season grasses with native warm-season remnants and/or woody encroachment. Cool-season grasses consist of western wheatgrass, foxtail barley, and Kentucky bluegrass. The remnant mid- warm-season grass includes little bluestem. The dominating presence of cool-season grasses and/or tree encroachment is an indicator that the Grassland State is at-risk of transitioning to a cool-season Grassland State and/or a Woody State. Prescription fires, timing, season of use, and providing a forage and animal balance to favor the warm-season grasses are the management actions that are needed to avert a transition. Total annual pounds of production varies from 3,300 to 4,500 with a representative value of 3,900.

Pathway 1.1 to 1.2
Community 1.1 to 1.2

Repetitive heavy use (grazing/defoliation) during the growing season, lack of rest, and recovery of the grazed key forage species, no prescribed fires, and/or no forage and animal balance may contribute to the cause of shift between community phases.

Pathway 1.2 to 1.1

Community 1.2 to 1.1

Providing a forage and animal balance, adequate rest and recovery of key plant species, and/or woody removal can contribute to the cause of shift between community phases. Shifts in community phases are reversible through succession, natural disturbances, short-term climatic variations, and use of practices such as grazing management.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

State 2
Cool-Season Grassland State

The Cool-Season State is supported by empirical data, historical data, local expertise, and photographs. The reference Grassland State ecosystem has been driven beyond the limits of ecological resilience and has crossed a threshold into the Cool-Season State. The designation of the Cool-Season State denotes changes in individual plant species and community composition. This change in plant species affects the biotic integrity of the ecosystem. The photosynthetic pathway of plants gradually transitioned from a warm- to a cool-season plant community. The replacement of plants will have an impact on grazing management, influencing the timing and season of use. Hydrologic function of the ecosystem may also altered by the growing season of the cool-season plants. This alternative state should be treated as a hypothesis that will be tested through long-term observation of ecosystem behavior and repeated application of conservation and restoration practices. This state should be re-evaluated and refined continually.

Community 2.1
Cool-Season Community

This community phase is a unique assemblage of perennial, cool-season grasses that have developed over time. This plant community is managed, unlike the Reference State communities in regards to timing of grazing and season of use. Cool-season grasses can complement warm-season rangeland by providing forage before and after the growing season of warm-season grasses. Tall-, warm-season grasses such as prairie cordgrass, big bluestem, Indiangrass, and switchgrass have been removed. Midsummer haying at the same time each year and/or continued heavy grazing without adequate recovery periods will accelerate this process. Western wheatgrass, Kentucky bluegrass, and foxtail barley are the dominant species that make up this community phase. A range of variability in dominance and sub-dominance of species occurs across the extent of this MLRA, and therefore is difficult to precisely define this plant community. Reed canarygrass and phragmites are species that could occur in this plant community as well. Field determinations will be necessary to determine soil dynamic property changes due to plant community change among this state. Total annual pounds of production ranges from 1,300 to 2,200 with a representative value of 1,700.

State 3
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 bases 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 3.1
Tree-shrub Plant Community

This community is dominated by trees with a canopy cover usually greater than 15-20 percent. Trees characterizing this community can include eastern redcedar, Siberian elm, Russian olive, and cottonwood. 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 retarding herbage growth. This provides a favorable habitat for seed germination and establishment of many woody species. Grass yields are significantly reduced, 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 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 percentage of canopy cover 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 woody species populations 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 4
Tillage State

The Tillage State consist 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). This is an alternative state since the energy, hydrologic, and nutrient cycles are functioning 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).

Community 4.1
Reseed Community

This plant community is created when the soil is tilled or farmed (sodbusted), and abandoned. All of the native plants are killed, soil organic matter and carbon reserves are reduced, soil structure is altered, and a plowpan or compacted layer can be observed, limiting water infiltration. Synthetic chemicals may remain as a residual in the soil from farming operations. In early successional stages, this community is not stable. Wind and water erosion is a concern within this plant community. This plant community can vary considerably depending on how eroded the soil was, the species seeded, the stand that was established, how long ago the stand was established, and the management of the stand since establishment. Prescribed grazing that incorporates adequate recovery periods between grazing events and a forage and animal balance is necessary to maintain the health, vigor, and productivity of desirable species. Selection of grass species by grazing animals on seeded rangeland sites can be significantly different from native range sites. Typically there is a reduced production level on seeded sites, compared to native sites with similar species composition. Species diversity is lower, and forb species generally take longer to re-establish. Seeded rangeland should be managed separately due to the natural ecological differences and livestock grazing preference.

Community 4.2
Go-back Community

This plant community originates when the soil is tilled or farmed (sodbusted), and abandoned. Generally land that has been used for purposes other than rangeland or hayland will start to revegetate when left undisturbed. Due to tillage activity there are no native plants, soil organic matter and carbon reserves are reduced, soil structure is altered, and a plowpan or compacted layer can be formed limiting water infiltration. Many times synthetic chemicals remain as a residual from farming operations. Wind and water erosion is a concern within this plant community. The initial ground cover will primarily consist of kochia, annual bromes, pigweed, foxtail (bristlegrass), Russian thistle, witchgrass, tumblegrass as well as other annuals. These plants give some protection from erosion and start to rebuild organic matter. The next succession of plants will be grasses such as sand dropseed, threeawn, silver bluestem, and annuals. Eventually, after decades, blue grama, sideoats grama, and buffalograss will come back. These species will not regain in proportions to that of the Reference State plant communities. Soil structure, aggregate stability, and organic matter will also not recover to conditions of the Reference State. Range seeding can accelerate the process of species composition and possibly production, but will be with high energy expense and inputs.

Transition 1 to 2
State 1 to 2

Long-term heavy grazing, inadequate rest and recovery of reference plant species, and an absence of prescription fire all contribute to the variables or events that contribute directly to loss of state resilience and result in shifts between states. This transition involves a change in vegetation photosynthetic pathways, resulting in a shift from warm-season-dominated grasses to cool-season grasses.

Transition 1 to 3
State 1 to 3

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 a reduction 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 to 4
State 1 to 4

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. 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.

Restoration pathway 2 to 1

State 2 to 1

Long term grazing management with adequate rest and recovery of the remnant Reference Plant Community species and a prescription fire are the management actions required to recover to the Grassland State. The species to target for management are those that were dominant within the Reference Plant Community, according to the functional/structural group sheet. This restoration may take greater than 20 years to accomplish.

Conservation practices

Prescribed Burning
Prescribed Grazing

Transition 2 to 3
State 2 to 3

The absence of managing woody species are the variables that contribute directly to loss of state resilience and result in shifts between states. This transition involves a change in vegetation type and a canopy cover of greater than 15% . This transition could take generations, and possibly will not occur if there is not a tree-shrub seed source available.

Restoration pathway 3 to 1
State 3 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, 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).

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-season Tallgrasses Dominant 60%**			2242–3194	
	big bluestem	ANGE	*Andropogon gerardii*	1328–1597	–
	eastern gamagrass	TRDA3	*Tripsacum dactyloides*	560–1334	–
	switchgrass	PAVI2	*Panicum virgatum*	263–796	–

	switchgrass	PAVI2	*Panicum virgatum*	263–796	–
	prairie cordgrass	SPPE	*Spartina pectinata*	263–796	–
	Indiangrass	SONU2	*Sorghastrum nutans*	140–532	–
2	**Warm-season midgrasses 5%**			112–269	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–179	–
	little bluestem	SCSC	*Schizachyrium scoparium*	56–179	–
	marsh muhly	MURA	*Muhlenbergia racemosa*	0–179	–
3	**Other grasses Minor component 10%**			56–532	
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–179	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–179	–
	slender wheatgrass	ELTRT	*Elymus trachycaulus ssp. trachycaulus*	0–179	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–179	–
	foxtail barley	HOJU	*Hordeum jubatum*	0–179	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–179	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–179	–
	reed canarygrass	PHAR3	*Phalaris arundinacea*	0–179	–
	plains bluegrass	POAR3	*Poa arida*	0–179	–
	prairie wedgescale	SPOB	*Sphenopholis obtusata*	0–179	–
4	**Sedges and rushes Minor component 5%**			0–269	
	river bulrush	BOFL3	*Bolboschoenus fluviatilis*	0–90	–
	sedge	CAREX	*Carex*	0–90	–
	mountain rush	JUARL	*Juncus arcticus ssp. littoralis*	0–90	–
	rush	JUNCU	*Juncus*	0–90	–
	bulrush	SCHOE6	*Schoenoplectus*	0–90	–
Forb					
5	**Forbs Subdominant component 15%**			392–796	
	goldenrod	SOLID	*Solidago*	56–151	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	56–151	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	56–151	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	56–151	–
	pitcher sage	SAAZG	*Salvia azurea var. grandiflora*	17–67	–
	Canada goldenrod	SOCA6	*Solidago canadensis*	17–67	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	17–67	–
	blue wild indigo	BAAU	*Baptisia australis*	17–67	–
	nineanther prairie clover	DAEN	*Dalea enneandra*	17–67	–
	swamp verbena	VEHA2	*Verbena hastata*	17–67	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–34	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–34	–
	Baldwin's ironweed	VEBA	*Vernonia baldwinii*	0–34	–
	scouringrush horsetail	EQHY	*Equisetum hyemale*	0–34	–
	prairie blazing star	LIPY	*Liatris pycnostachya*	0–34	–
Shrub/Vine					

6	**Shrub Minor component 5%**			17–269	
	leadplant	AMCA6	*Amorpha canescens*	17–56	–
	false indigo bush	AMFR	*Amorpha fruticosa*	0–56	–
	common buttonbush	CEOC2	*Cephalanthus occidentalis*	0–56	–
	prairie rose	ROAR3	*Rosa arkansana*	0–56	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–56	–

Animal community

Animal Community – Wildlife Interpretations

This ecological site is characterized by soils that are nearly level to weakly hummocky and are usually associated with the sandy rivers or streams. These sites have historically been subject to frequent flooding, sorting, scouring, and deposition. Therefore, vegetative composition can change quickly and frequently, often setting back succession literally overnight. As a result, virtually none of these sites have been cultivated. Since the majority of these areas are not farmed, they are often utilized for wintering areas by livestock, especially where trees are present. Overutilization by livestock tends to degrade terrestrial as well as aquatic wildlife habitat.

Historically these sites have supported a diversity of wildlife because of the mixture of forbs and grasses and the nearly steady supply of water. These forbs and grasses were utilized by a number of large mammals including deer, elk, and bison. Due to all landscapes inherent heterogeneity, 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.

If cottonwood trees become established on these sites, the types of wildlife species using the area will shift from grassland species to woodland species. Striped skunks, opossums, porcupines, and whitetail deer habitat will increase. Habitat also becomes more suitable for northern bobwhite quail and turkeys.

In recent times cottonwood trees have begun dying off as a result of irrigation and a corresponding reduction in the water table. With the loss of water flows, very few new trees are replacing them. These dead cottonwood trees have created ideal habitat for species that utilize dead “snags” such as northern flickers, red-headed woodpeckers, wood ducks, and raccoons.

The site's close proximity to permanent or seasonal water in streams generally meets the needs of wildlife requiring open water for drinking. Seasonal pools present 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.

Big Bluestem, Switchgrass, Indiangrass Reference Plant Community

The high diversity of grasses and forbs in this community provides habitat for a diverse group of insects. 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. Plains garter snakes and northern water snakes are common reptiles on the site. Areas with high forb and insect populations coupled with nearby roost trees offer suitable brood habitat for wild turkeys. Reference Plant Community sites in good condition with tall-, native warm-season bunch grasses and openings at ground level offer suitable northern bobwhite quail nesting habitat. Small mammals such as white-footed mice are common, and will attract raptors such as red-tailed hawks, great-horned owls, and eagles if suitable perches are available. Small mammals also provide prey for coyotes and other predators.

Animal Community – Grazing Interpretations

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangelands in this area provide yearlong forage under prescribed grazing for cattle, sheep, horses, and other herbivores. During the dormant period, livestock may need supplementation based on reliable forage analysis.

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

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 short-grasses 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

None noted.

Wood products

No appreciable wood products are present on the site.

Other products

None noted.

Other information

Site Development and Testing Plan

This site went through 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 was used extensively to develop this ecological site description.

NRCS individuals involved in developing the Subirrigated 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.

Range Condition Guides and Technical Range Site Descriptions for Kansas, Subirrigated, USDA, Soil Conservation Service, August, 1967.

Range Site Description for Kansas, Subirrigated, USDA-Soil Conservation Service, September, 1983.

Ecological Site Description for Kansas, Subirrigated (R073XY032KS)located in Ecological Site Information System (ESIS), 2007.

Other references

Brady, N., and Weil, R., 2008 The nature and properties of soils, 14th ed.

Bragg, T. and Hulbert, L., 1976. Woody plant invasion of unburned Kansas bluestem prairie. J. Range Management., 29:19-23.

Choate, J., and Fleharty, E., 1975. Synopsis of native, recent mammals of Ellis County, Kansas. Occasional Papers. The Museum, Texas Tech University. 37: 1-80.

Dyksteruis, E.J., 1958. Range conservation as based on sites and condition classes. J. Soil and Water Conserv. 13: 151-155.

Eddleman, L., 1983. Some ecological attributes of western juniper. P. 32-34 in Research in rangeland management. Agric. Exp. Stan. Oregon State Univ., Corvallis Spec. Rep. 682.

Hattin, D., 1962. Stratigraphy of the Carlile shale (upper cretaceous) in Kansas. Univ. Kans. Pub., State Geol. Survey of Kansas Bull. 156. 155 p.

Hester, J.W., 1996. Influence of woody dominated rangelands on site hydrology and herbaceous production, Edwards Plateau, Texas. M.S. Thesis, Texas A&M University, College Station, TX.

Holechek, J., Pieper, R., Herbel, C., Range Management: principles and practices.—5th ed.

Kuchler, A., A New Vegetation Map of Kansas. Ecology (1974) 55: pp. 586-604.

Launchbaugh, J., Owensby, C., 1978. Kansas Rangelands, Their Management Based on a Half Century of Research, and Bull. 622 Kansas Agricultural Experiment Station.

Moore, R., Frye, J., Jewett, J., Lee, W., and O'Connor, H., 1951. The Kansas rock column. Univ. Kans. Pub., State Geol. Survey Kans. Bull. 89. 132p.

National Range and Pasture Handbook, USDA-NRCS, Chapter 7, Rangeland and Pastureland Hydrology and Erosion.

National Climatic Data Center, Weather data, web site http://www.ncdc.noaa.gov/. Available online. Accessed 4/18/2017.

Rangeland Cover Types of the United States, Society for Range Management 1994.

Swineford, A., McNeal, J., and Crumpton, C., 1954. Hydrated halloysite in the Blue Hill shale, pp. 158-170. From clay and clay minerals (2nd conf.). Natl. Acad. Sci.—Nat. Res. Council Pub. 327.

Soil Series—Official Series Descriptions, https://soilseries.sc.egov.usda.gov/osdname.asp. Available online.

Accessed 4/17/2017.

Sauer, C., 1950. Grassland climax, fire, and man. J. Range Manage. 3: 16-21.

Thurow, T. and Hester, J., 1997. How an increase or reduction in juniper cover alters rangeland hydrology, In: C.A. Taylor, Jr. (ed.). Proc. 1997 Juniper Symposium. Texas Agr. Exp. Sta. Tech. Rep. 97-1. San Angelo, TX: 4:9-22.

USDA-Natural Resources Conservation Service—Soil Surveys and Web Soil Survey. Available online. Accessed 4/17/2017.

USDA Handbook 296, LRR and MLRA of the U.S., the Caribbean, and the Pacific Basin.

Waller, S., Moser, L., Reece, P., and Gates, G., 1985. Understanding Grass Growth.

Weaver, J. and Albertson, F., Deterioration of Midwestern Ranges, Ecology, Vol. 21, No. 2, April 1940, pp. 216-236.

Contributors

Chris Tecklenburg

Approval

David Kraft, 9/30/2019

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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 4/04/2017 David Kraft, John Henry, Doug Spencer, Dwayne Rice original 2/2005
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Date	09/30/2019
Approved by	David Kraft
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

2. **Presence of water flow patterns:** There is little, if any, evidence of soil deposition or erosion. Water generally flows evenly over the entire landscape.

3. **Number and height of erosional pedestals or terracettes:** There is no evidence of pedestaled plants or terracettes or the 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. Cover can be defined as live plants, litter, rocks, moss, lichens, etc.

5. **Number of gullies and erosion associated with gullies:** None

6. **Extent of wind scoured, blowouts and/or depositional areas:** There is no evidence of wind erosion creating bare areas or denuding vegetation.

7. **Amount of litter movement (describe size and distance expected to travel):** Plant litter is distributed evenly throughout the site. During major flooding events this site slows water flow and captures litter and sediment.

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. A soil fragment will not “melt” or lose its structure when immersed in water for 30 seconds. There is no evidence of pedestaled plants or terracettes. 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):** Ap--0 to 6 inches; very dark gray (10YR 3/1) moist, fine sandy loam; weak medium granular structure; soft, very friable; many roots throughout.

   A--6 to 16 inches; very dark gray (10YR 3/1) moist, fine sandy loam; weak coarse blocky structure parting to moderate medium granular; soft, friable; strong effervescence.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** There is no negative effect on water infiltration and/or runoff due to plant composition or distribution. Plant composition and distribution are adequate to prevent any rill formation and/or pedastalling. Inter-spacial distribution is consistent with expectation for the site.

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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: Warm season tallgrasses 60%: big bluestem 1185-1425, eastern gamagrass 500-1190, Indiangrass 125-475, prairie cordgrass 235-710, switchgrass 235-710.

    Sub-dominant: A variety of forbs make up 15% of the plant community.

    Other: Warm-season midgrasses minor component 5%; little bluestem 50-160, sideoats grama 0-160, marsh muhly 0-160. Cool-season grasses minor 10%; Scribner's rosette grass 0-160, western wheatgrass 0-160, Canada wildrye 0-160, and others.

    Additional: Sedges and rushes minor component 5%.
    Shrubs minor component 5%.

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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. 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):** 4,000-5,500 lbs/acre. Representative value is 4750 lbs/forage/acre. Below normal precipitation during the growing season expect 4,000 lbs/forage/acre and above normal precipitation during the growing season expect 5,500 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.

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:** None.

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.